DG 1110-3-112

DESIGN GUIDE
ARMY CONTINUING EDUCATION SYSTEM CENTERS

Department of the Army
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CHAPTER 1–INTRODUCTION

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The Design Guide (DG) series is issued under the standard design medium by the Engineering Division, Military Programs Directorate, Office of the Chief of Engineers, U.S. Army.

This guide governs design of Army Continuing Education System (ACES) Centers. The Army Continuing Education System Program is contained in AR 621-5. ACES Centers support the general academic, technical and vocational education of military personnel of all grades and ranks.

This guide provides planning and design guidance discussed separately and in the form of example designs which establish concept alternatives for evaluating project designs. This guide is applicable to all new construction projects for Army ACES Centers (Facility Category Code 740-25) and projects involving modernization of existing facilities.

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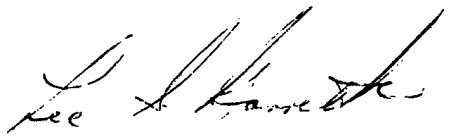
FOR THE CHIEF OF ENGINEERS:



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1-1 PURPOSE

a. PLANNING GUIDANCE. This guide provides general guidance to aid installation and Corps of Engineer personnel in the *planning* of Army Continuing Education System (ACES) Centers for inclusion in military construction programs.

b. DESIGN GUIDANCE. As the basic instrument governing the design of ACES Centers, this guide is primarily intended to aid architects and Corps of Engineers personnel in the *development and evaluation of project designs.* This guide is directed towards the improvement of early design decisions and the development of realistic, cost-effective facilities in conjunction with Army and Department of Defense criteria and procedures.

1-2 SCOPE

a. GUIDE LIMITATION. This guide is applicable to all new construction projects for ACES Centers. It is also applicable as general guidance to projects involving the conversion or modernization of existing facilities. It applies to all construction programmed under facility category code 740-25. The guidance and criteria must be applied, however, in conjunction with information obtained from each particular installation defining the installation's proposed ACES program, and the constraints and opportunities of the project site.

b. PRESENTATION OF GUIDANCE. This guide is structured to aid in the development of project requirements and designs that respond to variables of each particular installation. Chapter 2 provides planning guidelines to help delineate ACES program requirements, space needs and cost estimates for use in developing project requirements and programming data. Chapters 3, 4 and 5 provide general design criteria, individual space criteria and space organization principles for use in developing and evaluating design solutions.

c. EXAMPLE DESIGNS. Chapter 6 contains examples illustrating the definition of requirements and designs for ACES Centers at installations with military strengths of 6,000, 10,500, and 21,000 persons. The designs demonstrate the application of criteria presented in chapters 3, 4 and 5 in view of different installation variables. While indicating a suggested level of quality, they provide a means of evaluating proposed design solutions for actual projects.

1-3 REFERENCES

a. ACES PROGRAM FUNCTIONS. The following Army documents are important in understanding ACES program functions:

AR 621-5-Army Continuing Education System (ACES)

DA PAM 570-551-Staffing Guide for U.S. Army Garrisons

1-3 REFERENCES (cont'd)

b. DOD CONSTRUCTION CRITERIA. The following manual is important in understanding the basic criteria governing the planning and design of Department of Defense facilities.

DOD 4270.1-M-Construction Criteria Manual

c. PROJECT PLANNING AND DESIGN. The following regulations are important in understanding procedures for planning and designing facilities in conjunction with the development of Military Construction, Army (MCA), programs.

AR 415-15-MCA Program Development

AR 415-17-Empirical Cost Estimates for Military Construction

AR 415-20-Project Development and Design Approval

d. COMPLETION RECORDS. The following regulation is important in understanding the kind of records transferred to the installation upon completion of project construction.

AR 415-10-General Provisions for Military Construction

1-4 EMPHASIS

a. DESIGN QUALITY. Emphasis shall be placed on the quality of design since it will vitally affect the longevity, usefulness, efficiency and attractiveness of the ACES Center. In addition to life cycle economy and functional efficiency, the overall design shall exemplify regional character and an aesthetic rendering of both interior and exterior features.

b. DESIGN SERVICES. Architects for these facilities should be selected on the basis of knowledge in design of similar facilities, and a demonstrated imaginative approach to site and building design. They must also be considered for their ability to provide and accomplish *professional interior design* services.

c. USER INFORMATION. Provisions related to the enhancement of facility operation, maintenance and flexibility shall also be emphasized during design. Information to supplement construction completion records shall be prepared to instruct the installation on how to gain the most benefit from such provisions.

1-5 RESPONSIBILITIES.

a. INSTALLATION. The Installation Commander and those who are in active charge of the installation's ACES program and real property share the primary responsibilities of the installation. The installation is responsible for:

1-5 RESPONSIBILITIES. (cont'd)

(1) Development and approval of functional requirements in conjunction with the criteria in this guide.

(2) Justification of functional requirements falling beyond the scope of criteria.

(3) Preparation and submission of the *Project Development Brochure* required by AR 415-20.

(4) Obtaining action to gain site approval if the project is not sited in accordance with the HQDA approved master plan.

(5) Preparation and submission of *DD Form 1391, Military Construction Project Data, and supporting data* in accordance with AR 415-15.

(6) Approval of concept designs to certify compliance with functional requirements.

(7) Procurement and placement of related furnishings and equipment.

b. DESIGN AGENCY. The Corps of Engineers field office responsible for design shall insure that:

(1) Functional requirements of the installation are recognized and incorporated into the project design.

(2) Requirements of the installation fall within the scope of the criteria in this guide.

(3) Requests by the installation for deviations from these criteria are completely justified and documented.

(4) Quality standards for overall design are emphasized as stated herein.

(5) Assemblage of user information is complete at the completion of project construction, and provided, together with the completion records required by AR 415-10, to the installation (Facilities Engineer).

(6) Copies of appropriate user information are provided to the director of the ACES center.

1-6 DEFINITIONS

a. NET SPACE. The Net Assignable Square Feet (NASF) used for a specific function. It includes space required for internal (secondary) circulation within areas where appropriate.

1-6 DEFINITIONS (cont'd)

b. GROSS SPACE. The total space, in Gross Square Feet (GSF), of all floors within the outside dimensions of the building excluding central mechanical equipment space.

c. FUNCTIONAL REQUIREMENTS. Space, performance and operational requirements related to staff, instructional and support activities, including circulation.

d. SPACE ALLOCATION CRITERIA. Standards prescribed to define and evaluate acceptable space allotments to satisfy functional requirements. In this guide, such criteria are often given as net assignable square feet (NASF), or in percentages or subdivisions thereof.

e. DESIGN CRITERIA. Standards prescribed to define and evaluate acceptable utilitarian, environmental and aesthetic conditions to satisfy functional requirements.

f. SPACE ORGANIZATION PRINCIPLES. Rules exemplified in the organization of spaces into a building design.

2-1 GENERAL

This chapter provides procedures to aid in development of functional requirements and subsequent preparation of planning and programing documents. The ACES program is the planning base for developing requirements which are eventually embodied into a building program. This chapter discusses building program development, and in particular, how to determine space needs and related requirements for site improvements, furnishings and equipment.

2-2 ACES: THE PLANNING BASE.

The ACES is an integrated management system of voluntary educational opportunities. It helps soldiers to grow professionally within the Army and to transfer knowledge and skills gained to productive postservice employment. It is also an Army-Wide System of relatively uniform educational opportunities, decentralized to post level, and operated within HQDA policies. The composition and size of the instructional program projected over the next 10 years for each particular case will be the basis for delineating functional requirements.

a. INSTRUCTIONAL PROGRAMS. Most military installations have authorized ACES instructional progams for a wide range of needs and backgrounds. These programs are described below:

(1) Basic Skills Education Programs (BSEP). This includes basic literacy skills thru 5th grade level, educational skills thru 9th grade level, and educational skills for progression past E-5.

(2) High School Completion Program (HSCP). This gives soldiers a chance to earn a high school diploma or a State-issued high school equivalency certificate or diploma during off-duty hours. Soldiers may enroll, with Army tuition assistance in locally available high school completion programs.

(3) Associate Degree Program. Normally, student is awarded an associate degree for successful completion of an academic or technical course of study at a two-year community or junior college.

(4) Servicemen's Opportunity Colleges Associate Degree. This program allows maximum acceptance toward a degree of non-traditional learning experiences. The soldier can meet degree requirements with a minimum of 15 semester hours of resident credit taken at any time during the program.

(5) Baccalaureate and Graduate Degree Programs. Successful completion of these programs result in the award of bachelor's and or master's (or doctorate) degrees. Each post is encouraged to have at least one of each of these programs available either on-post or within reasonable commuting distance.

(6) Skill Recognition Programs. These voluntary programs show ways to get recognition within the civilian sector for skills soldiers learn in the Army. This includes: Accreditation of Military Experience, Army Apprenticeship, Industry Recognition, Industry Specialists and Certification.

2-2 ACES: THE PLANNING BASE. (cont'd)

(7) Skill Development Programs. These programs provide technically oriented courses in support of enlisted military occupational speciality development or in furthering vocational technical development to qualify for certification, to develop a skill that is both Army and civilian related, or to build academic credits toward associate degree requirements.

(8) Language Program. This includes training to develop simple, survival-level language skills, refresher and maintenance language courses to keep and to upgrade general language skills of those with basic linguist qualifications; duty or mission-related language instruction that improves specific job performance; English-as-a-Second-Language course to upgrade basic communication skills; voluntary language courses available for personal reasons.

(9) Correspondence Courses. These courses are offered through the Defense Activity for Non-Traditional Education Support (DANTES), including high school, college, and vocational/technical courses. Courses may be supplemented by local instruction in the ACES program.

b. OTHER ACES PROGRAM FUNCTIONS

(1) Career Advisory and Counseling (CAC). CAC programs are conducted by all ACES Centers. Counseling helps each active-duty soldier grow professionally by taking part in education programs and progressing toward their educational goals. The program ensures that each soldier is offered educational opportunity as advertised.

(2) Testing. Each ACES Center is required to provide an adequate testing facility and provide testing services for the programs conducted. Tests include academic proficiency, MOS proficiency, interest, aptitude, intelligence and general placement tests. Special emphasis is placed on DANTES examinations.

(3) On the Job Training (OJT). OJT is not normally provided under the Army's ACES program, thus this function is not discussed in this design guide.

c. STUDENTS

The ACES program primarily serves active duty military personnel, but may serve adult dependents, retired military personnel, and civilian employees on the installation when space is available.

(1) Enlisted Personnel. Soldiers without a high school diploma are urged to earn a high school diploma or state-issued high school equivalency by the end of the first enlistment and do one of the following: Have occupational skills certified which are learned through Army training and experience; or, acquiring an occupational skill through the skill development program.

(2) Officers. Warrant Officers are expected to complete an associate degree program or two school years of undergraduate study by the 15th year of service. The study must be in a career field related to

2-2 ACES: THE PLANNING BASE. (cont'd)

the soldiers specialty. Commisssioned Officers who lack a baccalaureate are encouraged to attain an undergraduate degree. Commissioned officers are urged to get a graduate degree. The degree may be in a discipline related to their specialty or in a shortage discipline determined by the Army Educational Requirements Board.

(3) Others; dependents, retirees, civilians, etc. Persons in this category are encouraged to make use of ACES programs, and will be admitted to programs in which space is available.

d. STAFF

For planning purposes the staff may be considered in two groups: administrative and counselor. These groups must be considered separately in terms of numbers of each type authorized. Specific staff functions and staffing levels are given in DA PAM 570-551. Instructors are normally contracted individually or from local and regional institutions, rather than being retained as permanent staff.

(1) Administrative. The administrative staff includes a director (Education Service Officer), administrators (Education Service Specialists), clerks (Administrative Specialists or Education Technicians), and typists. The administrative staff may also include a registrar, librarian and special program administrators. In some cases, individuals or institutions providing contracted services may also furnish administrative staff.

(2) Counselor. A staff of full-time counselors is authorized (one per 1,250 military personnel) to advise soldiers on the selection of courses and on career plans. AR 621-5, ACES, requires counselors to interview every new arrival at the installation during in-processing, and periodically thereafter, to assess the individual's educational background. Counselors are available to personnel throughout their stay on post.

e. INSTRUCTIONAL AIDS

(1) Audio-Visual. Films, slides, tape recorders, etc., are used to promote better learning by increasing the immediacy of experience. They are used extensively in language and reading instruction, and for teaching MOS-related material that involves the use of equipment under conditions that cannot be readily duplicated in the classroom.

(2) Self-Paced Learning. Programed instruction is frequently used, especially for MOS-related material. Students proceed at their own pace, and learning is broken down into small steps.

2-3 PLANNING REQUISITES AND DOCUMENTATION

The sequence of steps for planning is delineated in AR 415-15. Once a need for an ACES Center has been recognized by the installation, the building functional requirements and subsequent space needs

2-3 PLANNING REQUISITES AND DOCUMENTATION (cont'd)

must be established and documented along with the requirements of the site and future interior furnishings. This is the responsibility of the installation although assistance (using installation funds) may be obtained from the design agency if needed.

a. PROJECT DEVELOPMENT BROCHURES (PDB). Documentation is accomplished by first preparing a PDB as required by AR 415-20 and discussed in TM 5-800-3. Project requirements will be established in conjunction with the procedures and criteria in this guide.

b. DD FORM 1391 (MILITARY CONSTRUCTION PROJECT DATA). Preparation of DD Form 1391, with detailed justification paragraphs, is discussed in AR 415-15. Preparation of this form should be supported by the PDB previously prepared. All data entered on the DD Form 1391 must be carefully considered since project design must adhere to the requirements and estimates established thereon, as approved by HQDA. In preparing DD Form 1391, "DG 1110-3-112" should be entered under detailed justifications concerning criteria.

2-4 ANALYZING THE SITE

a. APPROVED GENERAL SITE PLAN. The site of the ACES Center must conform to the general site plan approved as part of the master plan of the installation. If the facility is not shown on the master plan, or if the shown location does not meet the current performance requirements of the using activity, then a new location must be selected and approval obtained in accordance with AR 210-20, Master Planning for Permanent Army Installations. Location is generally determined in response to the following factors.

(1) Central to the installation and close to library facilities for convenience of students and staff.

(2) Ready access from the main installation entrance for use by off-base personnel.

(3) Closer to enlisted than to officers' quarters since many enlisted may not have access to automobiles.

(4) Relatively quiet and uncontested area conducive to study.

(5) Soil characteristics and drainage to allow economical construction and siting.

(6) Sufficient real estate on site to permit buildings, parking, outdoor teaching areas related to vocational-training shops, access by service vehicles, and sufficient space for building expansion.

(7) Proximity to existing or planned non-ACES spaces which are usable for ACES functions, e.g., Arts and Crafts and Auto Crafts Centers.

(8) Proximity to dining facilities and other service facilities.

2-4 ANALYZING SITE (cont'd)

(9) Adaptable to barrier-free design for both able-bodied and handicapped persons.

b. PRELIMINARY SITE LAYOUT. Although a detailed site plan is not normally required for submission with the DD Form 1391, preparation of a site layout will assist in preliminary budgeting Tentative orientation of the building should take into consideration the following factors:

(1) Convenience of access for pedestrians, drivers of service vehicles.

(2) Direction of prevailing wind and sun angles.

(3) Land forms, grading, drainage, and tree coverage.

(4) Views (desirable and undesirable).

(5) Size, location and sufficiency of utility connections.

(6) Future expansion.

c. ESTIMATING SITE COSTS. Empirical cost estimating data are given in AR 415-17. Establishing the costs of site requirements is initially the most important consideration. Therefore, specific site requirements must be determined in conjunction with building requirements, and listed as separate items (Support Facilities) on DD Form 1391. The following list indicates typical items that should be considered.

Site preparation	Special foundations
Grading, paving (drives, parking and walks)	Fencing or walls
Demolition	Landscape planting
Water	Exterior electrical
Sanitary sewer	Communications
Gas	Signage

2-5 DEVELOPING THE BUILDING PROGRAM

a. MAXIMUM SPACE ALLOWANCES. Table 2-1 summarizes maximum space allowances for ACES Centers based on DOD Construction Criteria. Gross space includes maximum allowance for ACES activities, including Career Advisory and Counseling (CAC), to the outside dimensions of the building excluding central mechanical equipment space. Approximate mechanical space is a rough estimate of the additional space required to individually heat and air condition each size of building in a *moderate* climate. Corresponding figures obtained from determining the *actual space needs* as discussed in the following paragraphs, will identify the "gross space" and "mech space" requirements to be entered (Primary Facility) on DD Form 1391

2-5 DEVELOPING THE BUILDING PROGRAM (cont'd)

Table 2-1 Maximum Space Allowances

Military Strength	Authorized (1) No. Counselors	ACES (2)	CAC (3)	Gross Space	Approx Mech Space
251-1000	1	4125	500	4625	125
1001-1250	1	8700	500	9200	150
1251-2500	2	8700	580	9280	150
2501-3000	3	8700	660	9360	150
3001-3750	3	13500	660	14160	150
3751-5000	4	13500	740	14240	150
5001-6250	*5*	*16100*	*820*	*16920*	*150*
6251-7000	6	16100	900	17000	150
7001-7500	6	19800	900	20700	200
7501-8750	7	19800	980	20780	200
8751-10000	8	19800	1060	20860	200
10001-11250	*9*	*26300*	*1140*	27440	*300*
11251-12500	10	26300	1220	27520	300
12501-13750	11	26300	1300	27600	300
13751-15000	12	26300	1380	27680	300
15001-16250	13	31800	1460	33260	350
16251-17500	14	31800	1540	33340	350
17501-18750	15	31800	1620	33420	350
18751-20000	16	31800	1700	33500	350
20001-21250	*17*	*36300*	*1780*	*38080*	*400*
21251-22500	18	36300	1860	38160	400
22501-23750	19	36300	1940	38240	400
23751-25000	20	36300	2020	38320	500
25001-26250	21	40500	2100	42600	500
26251-27500	22	40500	2180	42680	500
27501-28750	23	40500	2260	42760	500
28751-30000	24	40500	2340	42840	500
30001-40000	25-32	48000	2420-2480	50420-50980	600
40001-50000	33-40	55000	3060-3620	58060-58620	600
50001-60000	41-48	60000	3700-4260	63700-64260	650

Notes: (1) Based on DA PAM 570-551 guidance allowing 1 counselor per 1250 military strength.
(2) Allowed by DOD 4270. 1-M construction criteria.
(3) Based on DOD 4270. 1-M criteria allowing 500 SF for 1 counselor; 80 SF per each additional counselor.

2-5 DEVELOPING THE BUILDING PROGRAM (cont'd)

b. ACTUAL SPACE NEEDS. Actual space needs must be based on the requirements of the ACES Program projected over the next 10-years, and calculated in terms of the instructional space types needed, existing spaces available and compatible with such needs, and the requirements for staff and support. Actual space needs should be determined as follows:

(1) List type and number of authorized and assigned staff for the given military strength.

(2) List the typical semester courses and student enrollment anticipated within 10-years for the ACES program. Consideration must be given to changes in circumstances which might affect the types of courses offered as well as the projected enrollment.

(3) Assign each course to a specific instructional space type. Use the Individual Space Criteria in Chapter 4, paras 4-3 and 4-4 for academic and vocational training type spaces, respectively.

(4) For each instructional space type, make a table similar to Table 2-2 and find "c", the total number of hours per week that the space type is required. The maximum class size should be based on the occupant load specified for each type of instructional space as given in Chapter 4.

Table 2-2 Projected Space-Type Utilization

Space Type: *Classroom*

Course Designation	Typical Semester Enrollment (1) In Students	Maximum Class Size (2) In Students	Number Of Classes Required (ENRM'T ÷ Cl. Size)	Number Of Hours/Week EA Class Meets	Hrs/wk Space Required (Classes x HRS. EA)
English I	*95 (ENRM'T)*	*24 (Cl. Size)*	4 *(Classes)*	5 *(HRS. EA)*	*20*
English II	20	24	*1*	*3*	*3*
Geometry	*5*	24			
Math I	*22*	*24*	*1*	*3*	*3*
History	*48*	24	*2*	*3*	*6*
English Lit.	*23*	*24*	*1*	*3*	*3*
Accounting	*60*	*24*	*3*	*3*	*9*
Geography	*18*	*24*	*1*	*3*	*3*
Reading	*17*	*24*	*1*	4	*4*
			Total Hrs/wk Space Type Required: C =		*51*

Notes: (1) Based on List of Typical Semester Courses and student enrollment anticipated within 10-years.
(2) Based on occupant load data for each type of instructional space given in Chapter 4.

2-5 DEVELOPING THE BUILDING PROGRAM (cont'd)

(5) Find the number of spaces of that type required (N). Use the formula N = c/uh in which:

c = total hours per week space type is required as discussed in (4)

u = room utilization rate: the fraction of time a space would be used while the ACES Center is in operation; normally u = 0.8

h = hours per week that ACES Center will normally operate.

If N is a fraction or a mixed number, round up to the nearest whole integer. Completion of this step will indicate the number of each type of instructional space required. Normally, a minimum of one MOS Library and Self-Paced Instruction area, and one Testing Room will be required. However, the Testing Room may be doubly used as classrooms reducing the number of those spaces which would otherwise be required.

(6) Survey Existing Suitable Facilities. Existing spaces which are or can be made available for ACES activities should have convenient access to necessary support facilities (toilets, storage, etc.). These spaces should be listed in two groups:

(a) Usable Spaces: within 8 minutes walking distance (2,000 ft.) of other ACES activities especially instructional activities, to permit movement within 10-minute class break; with no major functional problems and compatible with space allocation and other criteria in Chapter 4; and with no major problems related to operation, supervision, or availability. An Arts and Crafts Center or Auto Craft Center, in close proximity, should be considered in this group, especially with regard to providing suitable shop spaces.

(b) Conditionally Usable Spaces: over 8 minutes walk to other ACES activities but usable for courses which do not require movement to and from rest of ACES Center; and/or with functional, operational, supervision, or availability problems that permit restricted use or require extensive renovation.

(7) Determine Requirements for New Instructional Space. Subtract existing usable spaces from required spaces. Be sure that the spaces which are subtracted are compatible with the Individual Space Criteria for each type of instructional space they are to replace. Multiply the number of spaces required for each space type times the NASF space allocated for that type in Chapter 4.

(8) Determine Space Requirements for Staff. Determine staff space requirements in relation to the staff authorized and the Individual Space Criteria for staff spaces in Chapter 4. Subtract existing usable spaces as determined according to (6). Be sure that existing facilities contemplated for staff use are compatible with effective ACES operation as certain staff offices may have to be centrally located.

2-5 DEVELOPING THE BUILDING PROGRAM (cont'd)

Again multiply the number of spaces required for each space type times the NASF space allocated for that type in Chapter 4.

(9) Determine Requirements for Support Spaces. Determine support space requirements according to the individual space allowances given in Chapter 4, para 4-5. Consider use of existing spaces as support spaces especially where existing spaces are to be used as instructional and/or staff spaces.

(10) Determine Total Net Space. Add support spaces to instructional (academic and vocational training) and staff spaces to determine total NASF of new space required.

(11) Determine Gross Space. Gross space is determined by adding the space needed for such things as circulation, building walls, and utility closets within the effective outside dimensions of the building to the total net space required. One half area must be included for exterior covered passageways, balconies and stairs. A *rough* estimate of GSF required may be obtained by multiplying total NASF by a net to gross factor of 1.15.

(12) Compare Requirement Against Allowable. Check required gross space against maximum gross space allowances in Table 2-1. If the required space does not exceed the allowable, enter the figure on the DD Form 1391. If required space exceeds the allowable, revise requirements to conform with allowable. In revising the requirements, the following methods should be considered:

(a) Use 5-year projected needs, or current needs, in lieu of 10-year needs.

(b) Plan for use of Conditionally Usable Spaces as discussed in (6) (b).

(c) Increase Room Utilization Rate "u" in conjunction with the formula discussed in (5).

(d) Examine the net to gross factor for possible reduction.

(13) Determine Mechanical Space. Refer to the Approximate Mechanical Space column in Table 2-1 for a rough estimate of mechanical space needed in relation to gross space required. The actual size should be estimated by a mechanical engineer taking into account the existence of central energy sources, solar applications, etc. Enter the figure obtained on a separate line of the DD Form 1391.

c. OCCUPANT CAPACITY. Once space needs have been determined, the occupant capacity, in number of students and staff, can be determined by adding the occupant loads given in Chapter 4 for each type of instructional and staff space, taking into account the number of spaces required, by multiplying the occupant load accordingly. This will provide the maximum peak load of students and staff which might be in the building at any given time, and can be used to indicate Design Capacity.

2-5 DEVELOPING THE BUILDING PROGRAM (cont'd)

d. EXAMPLE DETERMINATIONS OF NEEDS AND CAPACITY. Development of space needs is demonstrated in Chapter 6; in most detail in para 6-2. Space requirements and occupant capacity are tabulated for the given military strengths of 6,000, 10,500 and 21,000 persons in Tables 6-8, 6-10 and 6-12.

e. ESTIMATING BUILDING COSTS. Empirical cost estimating data are given in AR 415-17. The unit cost data shown in AR 415-17 include equipment and furnishings which are permanently built into or attached to the structure. The following list indicates typical items that should be estimated as part of the building cost.

Built-in counters, cabinets, sinks and shelving.

Drinking water coolers

Central PA and speaker system

Telephone, fire alarm and intercom system

Built-in laboratory furniture, hoods and vents

Built-in typing and tape playing decks

Built-in movable partitions

Built-in projection screens

Elevators and conveyors

Waste disposers

Floor and window coverings

Chalk boards, tack boards and display cases

Signage and graphics

Special features for the handicapped

Other items which are normally installed as a permanent part of the building.

2-6 RELATED FURNISHINGS AND EQUIPMENT

a. COORDINATING REQUIREMENTS. Principal items of furnishings and equipment are listed in Chapter 4 under each individual space, generally on the figures showing space layout. Furniture and equipment that are *portable* or *detached* from the structure must be furnished by the installation. These items will be funded from some other appropriation than construction, and such must be carefully coordinated to insure availability of furnishings and equipment when required. All related furnishings and equipment needs must be identified in conjunction with Planning the building in order to develop a totally integrated and useful facility; and in order to program funds and provide information on delivery schedules in relation to construction. In preparing DD Form 1391, plans for related furnishings and equipment must be described in the detailed justifications.

b. ESTIMATING FURNISHINGS AND EQUIPMENT COSTS. Items "on hand" meeting furnishings and equipment requirements should be listed separately from items that must be procured. Sources for selection of furnishings and equipment to be procured, are provided in the GSA Federal Supply Schedules, the Federal Prison Industries Schedule of Products and the general GSA supply catalog. These sources are mandatory, insofar as they meet requirements, and cost estimates should be based on prices therein *escalated* to time of actual procurement to meet the established delivery schedule. Quality factors relevant to the selection of furnishings are discussed in Chapter 3, para 3-5. The following list indicates typical items of equipment and furnishings that should be considered.

Audio-visual equipment, TV systems

Training equipment and instructional apparatus.

Desks, chairs, tables, study carrels

Lounge furniture

Service carts and equipment

Storage and filing cabinets

Microfilm equipment

Reproduction machines

Wall clocks; plug in

Outside furniture

Other items which are detachable or portable

3-1 GENERAL

This chapter discusses basic considerations for design and review of ACES Center projects in relation to the individual space criteria and space organization principles in Chapters 4 and 5. The discussion includes the design requisites and documentation required, basic site development and building design criteria, considerations for related furnishings and equipment and provisions for user information. In addition, there are several overriding considerations that must be accounted for in all aspects of design.

a. BARRIER FREE DESIGN. ACES Centers must be accessible to all persons. Provisions will conform to ER 1110-1-102 and EM 1110-1-103, Design for the Physically Handicapped. Barrier free design is extremely important in both site development and building design and will provide valuable conveniences to the able-bodied as well as the handicapped.

b. ENERGY CONSERVATION. Use of energy conserving techniques relates to both site development and building design. Solar orientation, building compactness, and passive conservation measures as well as active measures will be considered for application as appropriate to each individual project.

c. FLEXIBILITY. The need for flexibility primarily relates to the need to make internal functional changes that may occur during the course of normal operation. Changes may routinely occur in courses being taught, teaching or training techniques and equipment, and student load. Multi-purpose use should be considered in the design of floor loads, ceiling heights, and wall systems. Provision of adequate storage spaces is extremely important as is the capability for adapting environmental services to changing requirements. Space specifically designed for a single purpose or space containing permanently installed equipment reduces flexibility and should be limited, insofar as possible, to areas whose functional requirements dictate that multi-purpose use is inappropriate.

d. LIFE CYCLE ENHANCEMENT. During design, consideration must be given not only to the initial cost of construction, but also to the cost of operation, maintenance, and custodial care during the intended life of the building. Both initial and life costs must be analyzed, especially in the selection of utility systems, exterior materials and interior finishes.

3-2 DESIGN REQUISITES AND DOCUMENTATION.

Project design development is discussed in AR 415-20. Use of the Project Development Brochure and DD Form 1391 data as approved by HQDA for inclusion in the proposed (or approved) military construction program, is prerequisite to design development which is the responsibility of the design agency.

a. CONCEPT DESIGN. Initially, concept design drawings and analyses are required to help verify costs, and further define the functional aspects of the facility before initiation of final design. Generally, the concept design will be completed by the design agency and *approved* by the installation before construction funds are actually appropriated. The following level of detail in documentation is required.

3-2 DESIGN REQUISITES AND DOCUMENTATION (cont'd)

(1) Site Plans. Site plans will show, as a minimum, floor elevations, existing and finished grades, existing and proposed buildings, roads, parking and utilities in the immediate project vicinity, outside utility connections, signage, existing vegetation, proposed lawns and planting masses, and solar orientation. Grading, paving, utility and landscape development plans must also be shown.

(2) Design Drawings. Design drawings will include as a minimum a graphic description of the design, including floor plans, sections, and elevations, with sufficient detail to describe the geometric and construction characteristics of the building; written specifications describing the required properties and/or performance of the construction, including materials, installation, workmanship and methods; and an interior design scheme with complete schedules of finishes, colors, patterns, and furnishings and equipment (attached and detached).

(3) Design Analyses. Design analyses will contain supporting data for all aspects of the design, including architectural, structural, mechanical, electrical and communication, fire safety, etc. Cost estimates for both primary and supporting facilities, will contain basic determinations commensurate with the level of detail of the rest of the design.

b. FINAL DESIGN. Final design will be based on the approved concept design. To, assure that approved concept requirements have been met, an in-process review of design documents by the installation should be made near completion of final design. Final documents must be sufficient to allow the project to proceed to competitive bidding and construction contract award. Basically, the final design will include a design analysis, drawings and specifications prepared in accordance with ER 1110-345-700, 710, and 720 respectively.

3-3 SITE DEVELOPMENT

Design of supporting facilities as part of the site development will be consistent with the project requirements previously established. Successful site design is embodied in developing an appropriate relationship between building and site, an efficient vehicular and barrier-free pedestrian system, and an overall landscaping and signage plan. These considerations are discussed in the following paragraphs. Reference should also be made to TM 5-803-3, Site Planning.

a. BUILDING-SITE RELATIONSHIP. In developing an appropriate building-site relationship, the terrain, soil characteristics, local vegetation, and climatic conditions of the site must be considered along with the utilities support, and relationships to other buildings in the area.

(1) Terrain Configuration and Site Coverage. The site design process requires analysis of the scale and character of the geographic and topographic features of the site. Large scale features, such as site slope characteristics, generally require specific architectural and landscape responses. Both large and small scale features should be considered from the standpoint of their potential landscape value. The building should be designed to blend with the contours of the terrain. If other considerations, such as solar orientation, dictate that the building cross contours, a multi-level building may be desirable. As a

3-3 SITE DEVELOPMENT (cont'd)

rule of thumb, the maximum recommended coverage of the site by the building is 40 percent. Optimum coverage is generally considered to be about 30 percent. Allowances for future expansion should also be considered.

(2) Soil Characteristics and Drainage. The organic composition and drainage characteristics of the soil is important to the design of building foundations and the economy of construction, as well as to the landscaping of the site. The drainage characteristics and compressive bearing strength of the soil are critical in foundation design and must be determined in accordance with TM 5-818-1, Procedures for Foundation Design of Buildings and other Structures. The determination of soil drainage characteristics will also include assessing the effects of the proposed building and its adjacent paved areas on the ground water level. Overlot grading must be established to provide positive drainage of the entire site away from the building and outside facilities. Grading should be designed for optimum preservation for existing ground forms and drainage patterns.

(3) Vegetation and Tree Coverage. Existing vegetation and trees should be preserved in their natural setting to the greatest extent possible consistent with functional requirements. This can help reduce the environmental affects of wind and sun, as well as the requirement for landscape planting and temporary erosion controls.

(4) Climatic Conditions. Skillful utilization of natural environmental controls can significantly increase building utility and efficiency.

(a) Wind. Structures affect air movement. They block or divert winds or channel them through narrow openings. Normally, the entrance should face away from the prevailing winds, or should be shielded by vegetation or part of the building. Features should be placed on the site so as to control wind-blown trash or snow, and aid in dispersal of emissions (smoke, fumes, dust).

(b) Sun. Solar controls should be planned to help achieve maximum energy savings. External shading devices are the most effective means of solar shading. Deciduous trees can provide shade in summer and penetration of sunlight in the winter.

(5) Exterior Utilities. Utility support systems must be carefully analyzed with respect to location, connection into the building and subsequent operation and maintenance. Utility areas, such as for transformers, utility connections, etc., shall be screened by use of plantings, land forms, or architectural screens to blend with the surroundings.

(6) Relationship to Other Buildings. The ACES Center will have been located during the planning process so as to establish some relationship to other community-type facilities. Subsequently, the site must be arranged to develop the relationship between the ACES Center and any existing spaces being used as well as the main library and service facilities such as the exchange, commissary, etc.

3-3 SITE DEVELOPMENT (cont'd)

b. PEDESTRIAN AND VEHICULAR SYSTEM. A safe and convenient pedestrian and vehicular system must be established. The system should separate pedestrian and vehicular activities as much as possible and incorporate requirements for the physically handicapped in accordance with EM 1110-1-103.

(1) Walkways. The pedestrian system is essentially established by the pattern of walkways designed to support access and egress to and from usable entrances of the ACES Center. Generally, walkways should be designed to complement the natural flow of pedestrian traffic, be 6' wide, and slope no more than 1 in 24 blending to a common level with other surfaces. Where significant level changes are required, both steps and ramps should be provided. Walks crossing roadways must be marked and provided with curb ramps, if curbs are used.

(2) Roadways. Vehicular arterials should not run through the ACES Center grounds or between the Center and closely related facilities such as the library. A pedestrian drop-off and pick-up zone should be provided near the main entrance to the Center, and be designed to be barrier free.

(3) Parking. A principal part of the vehicular system involves parking facilities for the cars and motorcycles of students and staff. The number of parking spaces required shall be based on a traffic analysis at the installation, taking into consideration time and space intervals related to the ACES instructional activities, and available mass transportation, car pooling, etc. A portion of the car parking spaces will be designed for use by handicapped drivers and *carefully* located to avoid having to cross a roadway to gain access to the building. Parking should be orderly and if possible dispersed and accented with landscape features.

(4) Service Access. Service roads and areas should be separated whenever possible from pedestrian oriented roadways, parking and walkways. In the outside areas related to vocational training; service requirements, car storage and parking may be combined. However, it is essential that the vehicular system provide access for fire fighting equipment, trash removal and other servicing equipment as well as for deliveries. Service areas and service roads must be sized to accommodate the turning radii and maneuvering requirements of the largest vehicles. At the same time, the extent of paving should be minimized. Screening for service areas should be accomplished in conjunction with the screening of utilities features.

c. LANDSCAPING AND SIGNAGE PLAN. In conjunction with establishing the building-site relationship and the pedestrian-vehicular system, a landscaping and signage plan will be developed.

(1) Signage. Direction signs and signs identifying buildings, parking areas, service areas, and facilities for the handicapped are required and shall be developed as an overall system together with the signage required for the building. Design shall conform to the signage criteria discussed under Building Design.

3-3 SITE DEVELOPMENT (cont'd)

(2) Landscape Perception. An important part of the landscape plan is consideration for the visual experience. A landscape is usually seen from an unlimited number of viewpoints, but a selected set of viewing positions can be designed into the landscape plan from where special features would be enhanced when viewed from those positions. Viewing positions will be established in conjunction with the design of the pedestrian system and the architectural image of the building. Sight lines from these positions must be carefully analyzed with respect to the visual and other aesthetic experiences to be created by the landscape plan; and with respect to the overall image to be established for the ACES Center. Sight lines from inside building windows are also important in developing the landscape plan as windows often function as focal points on the landscape as well as provide natural light.

(3) Planting Design. Existing land forms, trees and vegetation should be preserved and incorporated into the landscape plan wherever possible. Plants can be used to modify or enhance climatic characteristics, reduce noise levels and control the flow of air. New plant materials should be available locally, easily maintained, and compatible with the surrounding environment without excessive irrigation needs. Where new materials are used, the initial plant size should be adequate to give the desired visual and protective effects. Parking areas should be screened with buffer planting and variegated with substantial islands of vegetation. For details on planting design, reference should be made to TM 5-830-1.

(4) Outside Furnishings. Where outside instructional activities or other functions such as study or waiting occur, appropriate furniture and equipment will be provided as part of the overall landscape plan. Provide bicycle racks to accommodate bicycle parking as appropriate. Trash receptacles, bollards, light standards and other common site elements shall be designed as part of an overall scheme. Items, fully attached to the site or building, will be included as part of the construction contract. Portable items will be included as part of the Related Furnishings and Equipment information to be developed for procurement by the installation.

(5) Lighting. Provide general parking and walkway lighting of 2 foot-candles at ground level. Areas accessible to the handicapped after dark must be lighted to 5 foot-candles at ground level.

3-4 BUILDING DESIGN

Building design will basically conform to the project requirements previously established, and applicable DOD, Army and Engineer criteria. The quality of building design may very well determine whether or not the ACES facility will maintain its usefulness and value. In this respect, successful development of the building's architectural image, functional layout, structure and environmental support systems, and interior detailing is of prime importance.

a. ARCHITECTURAL IMAGE. The architectural image is established by the characteristics of design that make the building appear inviting, adapted to the environment, and identifiable as an ACES Center.

3-4 BUILDING DESIGN (cont'd)

(1) Inviting Design Characteristics. The ACES Center must reinviting and convenient to visitors as well as routine users. Especially important are the location, expression, and identification of entrances in relation to the approaches on the building site. The design of the ACES Center should reflect the scale and nature of the activities involved and invite participation therein.

(2) Adaptation to Environmental Context. One measurement of good building design is the success with which the facility is adapted to its particular environment. Specifically, such factors as site and climate provide the basis for determining appropriate architectural responses. For example, a hot, sunny environment requires a facility that provides protection from heat and glare, with entrances that accomplish a comfortable transition between the bright sun on the exterior and the relatively dark interior. In wet climates, rain protection at exits and between building elements should be considered, and in colder climates, compact buildings that increase floor space per unit area of exterior surface and door circulation should be used. Environmental considerations such as these are an integral part of an attractive and functional design.

(3) Facility Identity and Perception. The ACES Center building must be readily identifiable as a unit and have a visually apparent organization that facilitates orientation and circulation. These basic perceptual qualities are essential to the further development of a system of viewing positions and settings to communicate the aesthetic intent of the building design. A series of viewing positions, intentionally planned into the approaches to the building and continuing on into the space organization within, shall be established for this purpose, and identified in the design analysis. The settings will be composed of elements of the building design, such as the sizes and shapes of the building's exterior masses and interior spaces, the color, texture and lighting of those elements, and the visual articulation or decoration thereof.

(4) Exterior Detailing. The color, texture and scale of building materials should generate visual interest, as well as establish characteristics appropriate to the overall scale and image of the installation. The articulation of the exterior mass of the building is also an important consideration.

(a) Wall Shading. A substantial proportion of the air conditioning requirement for most buildings results from solar energy absorbed by building surfaces. By simply shading those portions of building receiving the most sun, cooling requirements can be significantly reduced. Methods of wall shading which should be considered include applying various forms of canopies or louvers to the walls, and use of deciduous trees. Each wall of the building may require a different treatment depending upon its orientation to the sun.

(b) Control of Glass Areas. In cases where the shading methods (mentioned above) are not practical, the choice of window glass becomes important. At a radiation angle of incidence of 40 degrees, ordinary glass admits 85% of the solar thermal energy that strikes the glass surface, while reflective glass admits 63%, heat-absorbing glass 60% and certain specialized glasses as little as 28%. Windows may also be recessed as illustrated in Figure 3-1. Such a design shades the window glass, substantially reducing the amount of solar energy striking the glass surface.

3-4 BUILDING DESIGN (cont'd)

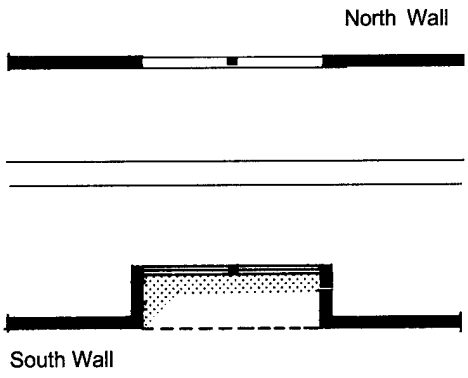


Figure 3-1 Glass Shading, South Elevation

b. FUNCTIONAL LAYOUT. The layout of ACES facilities is an extremely important part of the building design, affecting both the operational efficiency and performance of ACES activities as well as the cost of construction. An effective functional layout must relate to a standard space module, accommodate circulation flow and adjacency requirements, and conform to life safety criteria.

(1) Standard Space Module. Buildings are generally more economical to construct if designed in relation to a standard space module. A commonly accepted module in the building industry is the 5-foot square. Systems such as for ceilings, walls, lighting and air distribution are manufactured to readily adapt to the 5-foot module. Space allocation criteria contained in Chapter 4 reflect use of the 5-foot module in defining the NASF allowed for the various functions of the ACES program.

(2) General Instruction Space Modules. instructional spaces are required that will seat 12 to 25 students, occasionally up to 50; be easily convertible to other uses; and minimize disruption of activities during modification of use. Based on these requirements, a general instructional module of 30' x 25', expandable to 30" x 50' as shown in Figure 3-2 will be used where practicable. This 750 SF module provides ample space, in the proper dimensional proportions for 25 students seated at tables, for general classroom activities. Two 750 SF modules placed side by side form a 1500 SF module ample enough for 50 students for large lecture activities. Divided by fixed or movable walls into 375 SF modules, there is ample room for 12 students for seminar purposes.

(3) Adjacency Requirements. In developing the building design to meet the performance needs of the ACES program, spaces must be laid out to achieve essential adjacency relationships. Basically, there are three kinds of spaces needed to accommodate ACES program functions; staff spaces, instructional (academic and vocational) spaces, and support spaces. Each group of spaces represents in itself an overall adjacency relationship. The relationship of one group to another is an element of basic spatial organization as discussed in Chapter 5. The relationship of one individual space to

3-4 BUILDING DESIGN (cont'd)

another, as discussed in Chapter 4, is an element of functional layout. Generally, this is based on the degree of interaction of personnel, material or activities between two or more spaces. The greater the degree of interaction, the closer the spaces should be together unless there are interposing requirements for safety, or need for acoustic or visual separation.

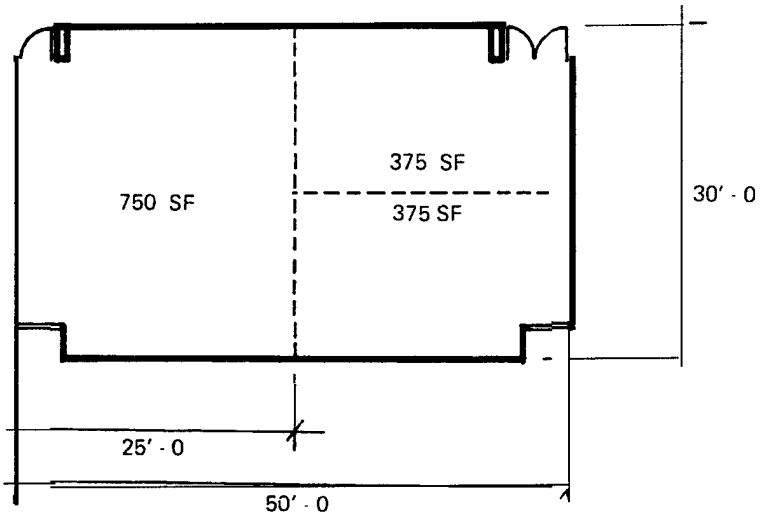


Figure 3-2 Modular General Instruction Space

(4) Circulation Flow. Corresponding with the layout of space adjacencies, a convenient and workable circulation flow must be established. The flow of students and staff; materials and services should not interfere with one another even though they must interface at certain points. Circulation requirements will greatly depend upon how well adjacency requirements are satisfied, and whether or not space organization assists orientation to the building. Spaces used frequently by persons unfamiliar with the ACES Center should be near the main entrance, and those that generate heavy traffic should be located close to entrances or circulation nodes. Like most education facilities, there will be predictable surges of circulation at the beginning of the instructional day, during break periods and the lunch hour, and at the end of the instructional day. Circulation systems must be capable of safely and comfortably handling these routine peak loads as well as those that might be experienced during an emergency evacuation of the building.

(5) Circulation Nodes. Horizontal circulation spaces should widen at points of queuing and decision, such as at corridor intersections, toilets and entrances to stairways. Such nodes should permit places for people to pause and possibly sit. At building entrances, the circulation space must provide for entering personnel to orient themselves and exiting personnel to prepare for outdoor

3-4 BUILDING DESIGN (cont'd)

weather conditions. A circular node should also be provided at elevators required to accommodate physically handicapped persons in multi-storied facilities.

(6) Evacuation. The building's functional layout must conform to life safety requirements. Evacuation during an emergency depends upon getting all of the occupants out of the building safely. This, in turn, means that limitations may have to be placed upon space sizes, locations and distances from exits. Also exits and passageways from the building must be sufficient in number and size. In most emergencies, elevators will become unusable; therefore, rescue areas or other measures may have to be considered for protection of the handicapped in multi-storied buildings.

(7) Related Considerations. Functional layout may also be affected by other considerations. For example, areas where surveillance is desired should be laid out in such a way as to allow visual control of circulation and other activities. Spaces with functions having common characteristics such as high noise levels or fire hazards; or special requirement for interior detailing, structure and environmental support; should be grouped together insofar as functional requirements for adjacencies will allow. Analyses should incorporate these and other considerations as appropriate to meet the requirements of each individual project.

c. STRUCTURE AND ENVIRONMENTAL SUPPORT. A successful building design must provide economical structure and environmental support systems selected for their ability to effectively support functional requirements and to operate efficiently. Environmental support includes heating, ventilation and air conditioning, lighting, electrical power and communication, plumbing, fire safety and acoustics.

(1) Structural Design. Design Loads and criteria will be in accordance with DOD 4270. 1-M and TM 5-809-1 through 6, 8 through 12. The structural systems and materials selected will be suitable for permanent type construction, be capable of carrying the required loads, conform to the standard space module, and be compatible with fire protection requirements, architectural concepts and functional requirements. The structure selected will be that system which is the most economical and suitable based on comparative cost studies for the building.

(2) Protective Construction. Design of structures for protection against seismic events and wind storms is prescribed in TM 5-809-10 and TM 5-809-11 respectively. In locations where a deficit in PF 100 fallout shelter space exists under the Army Survival Measures Plan, described in AR 500-72, selected areas of the structure will also be designed for dual use as fallout shelters. Technical and other requirements will be in accordance with TM 5-800-1, Construction Criteria for Army facilities. Single-line plans showing locations, occupant loads, and minimum protection factors for the selected shelter areas shall be developed and included in project design analyses and completion records.

(3) Ventilation, Temperature and Humidity Control. A controlled thermal environment is an important factor in designing comfortable, safe, and effective instructional spaces. Investigations in the area

3-4 BUILDING DESIGN (cont'd)

of human performance show that when temperature and humidity become high, working efficiency decreases, errors increase, and under extreme conditions health is adversely affected. In areas such as shops, in which students are working with equipment and machinery, temperature and humidity control may be required for safety purposes. Likewise, ventilation or exhaust systems may be required for health. All provisions must be consistent with applicable Occupational Safety and Health Act (OSHA) standards.

(a) Temperature Control. Whenever the daytime outside temperature is above 55 degrees F., heat gains will usually outweigh losses. Therefore, the fundamental problem in controlling the thermal environment in an ACES Center is cooling, rather than heating the facility. The desirable temperature for a building depends on the activity of its occupants. Acceptable temperature limits vary from 60-70 degrees for vigorous activity to 68-78 degrees for sedentary activity. In an ACES Center, where learning activities range from sedentary to vigorous, separate temperature zoning should be provided. For example, shop areas should be zoned for lower temperature than classrooms or staff areas.

(b) Humidity Control. Relative humidity has little influence on comfort, provided that it is in the intermediate range (30% to 70%). Humidity levels above 70% can impair human performance and levels below 30% can cause respiratory discomfort and create undesirable levels of static electricity in activity spaces.

(c) Ventilation. In a closed, occupied space, the amount of oxygen in the air decreases and the amount of carbon dioxide increases. Normally, ventilation of 6-10 air changes per hour is sufficient for maintaining the proper balance between oxygen and carbon dioxide. Dust, pollen, and bacteria should be eliminated by air filtration. Ventilation criteria for individual spaces are summarized in Chapter 4, Table 4-1. Air distribution systems should provide uniform air velocities generally not exceeding 40 feet per minute for an air-conditioned draft-free environment.

(4) Mechanical Design. Heating, air conditioning and mechanical ventilation shall conform to the applicable portions of DOD 4270. 1-M and TM 5-810-1. Heating and air conditioning load calculations shall comply with the procedures of the latest ASHRAE Handbook of Fundamentals. The "U" values for exterior walls, ceilings, and floors shall be in accordance with DOD 4270.1-M. Design temperatures shall be 68°F. for heating; 78°F. for cooling. Various systems should be considered to accommodate the environmental requirements of the different types of spaces in the ACES Center. Selection will be based on performance, least energy use and cost of operation and maintenance. Energy recovery systems should be investigated and incorporated into the design if economical. Reasons for selection and rejection of systems must be included in project design analyses.

(5) Lighting. An appropriate visual environment with adequate lighting is essential for effective learning. A well lighted classroom enhances auditory as well as visual perception.

(a) Illumination Levels. Research has established that a lighting level between 20 and 50 foot-candles is adequate for the comfortable and efficient completion of most tasks. However, it is

3-4 BUILDING DESIGN (cont'd)

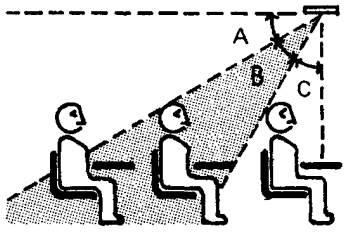
recommended that illumination be designed to supply 70 foot-candles on all educational and office tasks, since accurate reading of pencil handwriting demands higher illumination levels than most other visual tasks. Lighting levels higher than 70 foot-candles are not required. Lighting level criteria for individual spaces are summarized in Chapter 4, Table 4-1.

(b) Adapting to Illumination Changes. In moving from one space to another, an important consideration is the ability of the eye to adapt to light and darkness. Only 35 seconds are required for partial, yet safe, adaptation when moving from a dark space to a lighted area. When moving from light to dark, however, minimal adaptation requires two minutes, total adaptation up to half an hour. Since personnel entering the ACES Center will be coming from the outdoors, where the level of illumination may be anywhere from 2,000 to 5,000 foot-candles, it is important to provide adequate lighting in entry spaces to permit gradual adaptation to interior light levels.

(c) Lateral Differences in Illumination. When personnel are placed in an environment where illumination on either their left or right is significantly greater than that on the opposite side, their eyes are subjected to distracting and uncomfortable stresses. This situation often occurs in classrooms where windows allow exterior light to stream in from one side of the students' field of vision while the other side is more dimly lighted from the interior. Avoid such conditions by designing the seating so that the windows are behind the students or when this is not possible, moderate the entering light with shading or other light-attenuating devices.

(d) Task-Background Illumination Levels. In general, the task (paper, book, item of equipment) confronting the student should be brighter than the surrounding environment. For optimum contour and depth perception, it should be three times as bright. Contrasts greater than this produce distortions. In no case should the task illumination level exceed ten times the general lighting level.

(e) Veiling Reflections. Design lighting so as to minimize light which is reflected off the task or nearby surfaces directly into the student's eyes. In general, this involves selecting and placing the light fixture so that the angle of incidence measured from the vertical is greater than 30 degrees, with as much light as possible falling within the 30 to 60 degree core as shown in Figure 3-3.



A O degrees – 30 degrees
Fixture Glare

B 30 degrees – 60 degrees
Optimum Light

C 60 degrees – 90 degrees
Veiling Reflections

Figure 3-3 Optimum Lighting

3-4 BUILDING DESIGN (cont'd)

(f) Glare. Design lighting so as to minimize light shining directly from the light sources into the student's eyes. This can be accomplished by selecting and placing light fixtures to direct the light below a 60 degree angle of incidence, with, again, as much light as possible falling in the 30 to 60 degree core (see Figure 3-3). Lighting fixtures with low brightness characteristics that produce a "bat-wing" light distribution pattern, as shown in Figure 3-4, are one means of satisfying this requirement.

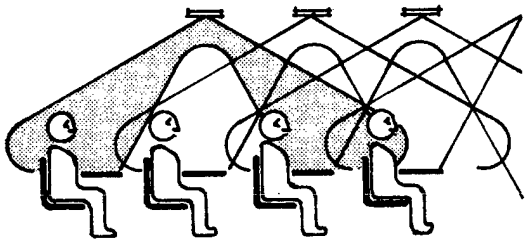


Figure 3-4 Bat-Wing Lighting Distribution

(6) Communications. The building telephone and intercommunication requirements are summarized in Chapter 4, Table 4-1. Telephones and lines will be provided by the installation Communications/Electronics Officer, however, outlets and the distribution system must be provided as part of the building design.

(a) Intercom-PA System. Provide an intercommunication-public address system consisting of a master station in the staff area capable of selectively paging through individual loudspeakers in selected areas and offices. The loudspeaker stations should be the talk-back type, and include a conveniently located master station call button. The master station should have volume controls on input and output, an all-call feature, and indicators for announcing incoming calls. Speakers should be the flush-mounted type. Medium and large size classrooms must be furnished with receptacle and wiring for microphones and speakers for amplified audio distribution.

(b) Central Television System. Where a central television system is required, the system must be coordinated with the installation Communications/Electronics Officer at the earliest practicable phase of design. TV outlets must be located for convenience, given the room layout and functional activity involved. Choice of using existing CATV or MATV system facilities, or the provision of a complete building antenna must be determined. Where a non-Government owned system is to be utilized, built-in system features such as empty conduits and pull wires, terminal cabinets, and outlets only will be provided in the building design.

3-4 BUILDING DESIGN (cont'd)

(7) Electrical Design. Electrical design must conform to DoD 4270.1-M and TMs 5-811-1 through 4. The system selected will provide efficient and economical electrical service throughout the ACES Center. Voltages selected will be of the highest order consistent with the load served. Three phase 208Y/120 volts should generally be used to serve incandescent and small fluorescent or mercury vapor lighting loads, small power loads, and receptacles. Consideration should be given to the use of three-phase 480Y/277 volt systems where such is feasible. Distribution of power within the building should be located to afford maximum flexibility in room power supply and ready accessibility for circuit revisions. Primary electric service will be underground to a pad mounted transformer(s) located outside below grade where possible, and as close to the load centers as practicable. Building telephone service will also be underground with main terminal cabinets located in mechanical or electrical equipment rooms. Communication systems must be coordinated with the local Communications/Electronics Officer. Evidence of such coordination will be provided in the project design analysis document.

(8) Toilet Fixtures. Both female and male toilets shall be provided to allow for convenient use by staff and students, including those who may be handicapped. Male-female ratio and fixture allocation are specified in Chapter 4 under individual space criteria for toilets, paragraph 4-5.e. At least one water closet and lavatory for each sex will be provided for the physically handicapped in accordance with the distance of travel and other criteria contained in EM 1110-1-103. Provide at least one drinking fountain per 100 persons. All computations should be based on the peak daily occupant load determined by adding up the occupant loads of all of the instructional and staff space in the ACES Center.

(9) Plumbing Design. Plumbing must be in accordance with TM 5-810-5 (and TM 5-810-6 if gas fittings are required). Water supply facilities must be as prescribed in TM 5-813-3 and 6. Sanitary sewers must be as prescribed in TM 5-814-1. Plumbing and fixtures shall comply with the "American National Plumbing Code A 40.8" or the "National Standard Plumbing Code," within the limits established by DoD 4270.1-M.

(10) Life Safety. Design provisions shall be made to assure health and safety as set forth in Occupational Safety and Health Act (OSHA) standards and National Fire Protection Association (NFPA) Codes augmented by DOD and Army criteria. Fire protection is a significant part of building design and involves the provision of resistive construction, detection and alarm systems, and extinguishment systems.

(a) Resistive Construction. Requirements for fire-rated walls, doors, floors, etc., depend upon the type of occupancy or hazards within a space. The objective is to contain and retard fires to allow evacuation, rescue and extinguishment. Resistive construction is especially important around passageways used for emergency exit.

(b) Detection and Alarm. Alarm systems are used as a general alert of danger whenever a fire occurs and is detected. Alarms can be supplemented by either heat or smoke detectors that sound an

alarm automatically. In designing a system, consideration should be given to visual as well as audible alarms to aid those with hearing handicaps; to resisting vandalism; and to maintaining and checking the system's performance. Tie-in with the installation fire department may also be required along with annunciators to show which detectors and/or alarms are activated.

(c) Extinguishment. Sprinkler or other systems may be used or required in high hazard areas, e.g., in educational or storage spaces where hazardous materials are handled. These systems are normally activated automatically by heat. An automatic sprinkler system shall be provided in all portions of ACES Center buildings located below the floor of exit; in all windowless classrooms, shops and educational spaces not having exits leading directly to the outside; and in all shops, classrooms and storerooms in which hazardous materials are handled. Spaces where special electrical or mechanical devices such as computers, simulators, etc., are to be housed must be identified so that alternative extinguishment systems can be designed accordingly.

(d) Safety Signals, Lights and Symbols. Emergency exits from corridors should be marked so that a sign indicating the nearest exit is visible from every point in the corridor. Provisions for those with visual, as well as other physical impairments, must be made in accordance with applicable design criteria used in design for the physically handicapped. Illuminated exit signs and emergency lights for all emergency exits and passageways will be provided as required by the Life Safety Code, NFPA No. 101. The location of fire protection and other fire safety equipment should be emphasized, where possible, with pictographs such as shown in Figure 3-5. Safety markings; signs for danger, warning or caution such as shown in Figure 3-6, should be designed in accordance with AR 385-30, Safety Color Code Markings and Symbols, and OSHA requirements.

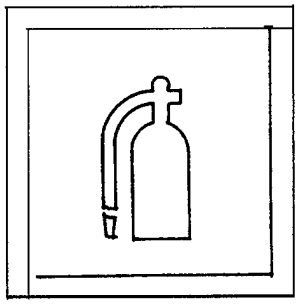


Figure 3-5 Pictograph of Fire Extinguisher

3-4 BUILDING DESIGN (cont'd)

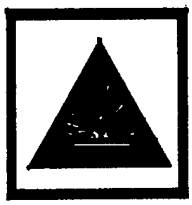


Figure 3-6 Safety Marking

(11) Fire Protection Design. Criteria for fire protection, including fire and/or smoke detection, fire alarm and extinguishment systems, are prescribed in DoD 4270.1-M, TM 5-812-1 and TM 5-813-6. These are generally based on the NFPA's National Fire Codes. Corridors, rooms and exits must conform to the requirements for "flexible plan" buildings given in the NFPA Life Safety Code 101. Single-line plans showing fire-rated construction, location of detection and alarm systems, the location of exits and travel distances to them, areas where sprinkler and/or extinguishing systems are provided, and the location of other fire protection features shall be developed and included in project design analyses and completion records. These documents will indicate coordination of the fire safety design with the installation fire marshal.

(12) Physical Security. The lock and keying system along with requirements for intrusion detection and protective lighting must be coordinated with the installation facilities engineer. Normally, locks will be grand master keyed to the installation's master key system and with the ACES Center keyed to a sub-master key. The further need for master keys for selected parts of the Center should be considered. Overall, the physical security system must be designed so that its operation can be maintained effectively without interfering with life safety features.

(13) Acoustics.

(a) Ambient Noise. Ambient noise is the background noise associated with a given space. It is generally a composite of sounds from mechanical equipment, street noise, and noise from nearby habitable spaces. The design ambient noise level for each ACES Center space is given in Chapter 4, Table 4-1 in terms of A-weighted sound levels in decibels (dB).

(b) Generated Noise. Generated noise is the estimated overall peak airborne sound level in a given space, created by typical activities. The peak estimated sound levels for each individual space are also given in Table 4-1 for consideration in determining noise compatibility. These levels are generally 10-15 dB higher than the average long-term levels should be for each respective space.

3-4 BUILDING DESIGN (cont'd)

Table 3-1 Sound Reduction Goals

GROUP 1	Rehearsal Recording Studio	55				
GROUP 2	Director's Office Administrator Office Clerk Office Counselor Office MOS Library Testing Room	40	60	65		
GROUP 3	Classroom Lecture Room Seminar Room Language Laboratory Science Laboratory Self-Paced Instruction	40	50	70		
GROUP 4	Staff Lounge Student Lounge Vending Area Training Aids Preparation Typist Area Information/Registration	40	50	varies		
GROUP 5	Htg/Refrig/AC Shop Electrical Shops Automotive Shops Building Trades Shops Toilets Receiving Room	40	no acoustic requirement			
GROUP 6	Storage Areas	no acoustic requirement				

		45	55	varies		
		45	varies			

Numbers represent sound reduction goals in decibels (dB) between spaces

Sound reduction should be measured in accordance with ASTM E 597-77T

3-4 BUILDING DESIGN (cont'd)

(c) Sound Quality. This relates to the type of response a room should make to the noise generated within. A "live" room should have a low average absorption coefficient with hard surfaces to reflect most of the sound. Conversely, a "dead" room should have a high absorption coefficient with surfaces to absorb sound. Values given in Chapter 4, Table 4-1 for sound quality are abbreviated as follows: L = live, ML = medium-live, AVE = average, MD = medium dead, D = dead.

(d) Sound Reduction. Building design should allow a reduction in sound between ACES spaces as indicated in Table 3-1, Sound Reduction Goals. Each group of spaces have similar acoustic requirements. Reduction is achieved by a combination of interposed distance and barriers.

(e) Maximum Sound Level. Loud and sustained noise can be a hazard to hearing. The safe limit for an unprotected ear is approximately 135 dB. At 150 dB even short-term exposure may cause damage. These facts have important implications for the design of shop areas, where high intensity noise is frequently a problem.

(f) Effect of Distance and Interposing Barriers. Sound dissipates over distance. Doubling the distance from a sound source reduces the level of sound received by 6 dB. A similar reduction occurs for each doubling of distance between source and receiver. The operation of heavy armor or transportation equipment produces between 80 and 120 dB of sound at a distance of 20 feet. Aircraft may produce in excess of 140 dB. Assuming 100 dB at 20 feet, such sound would diminish to 94 dB at 40 ft., 88 dB at 80 ft., 82 dB at 160 ft., 76 dB at 320 ft., on up to 34 dB at 40,000 ft. (7 1/2 miles), etc. Since 35 decibels is the maximum desired ambient noise level for classrooms and study areas, distance alone generally is not a practical solution to reducing sound between the classroom environment and the outside environment or other related environments containing high noise producing sources. However, if such sources can be located at a distance remote enough to allow reduction of the noise to an ambient noise level around classrooms of 65 decibels, normal construction barriers can be reasonably designed to further reduce the noise to acceptable ambient levels within the classroom.

(9) Background Noise. Background noise is most distracting when the frequency range of the desired audio stimuli and the background noise are similar. For example, voice noise of 35 dB is more disruptive than mechanical ventilation noise of 35 dB.

(h) Reflective and Absorptive Surfaces. To reinforce an instructor's voice and help eliminate distracting reverberations in classrooms and other similar rooms, the ceiling, the wall behind the instructor's station, and the upper half of the side walls should be provided with sound reflective surfaces as shown in Figure 3-7. The remaining surfaces of the room should be sound absorptive so that noise generated close to the floor, e.g. dropping objectives, scuffling of shoes, or the moving of chairs, is reduced.

3-4 BUILDING DESIGN (cont'd)

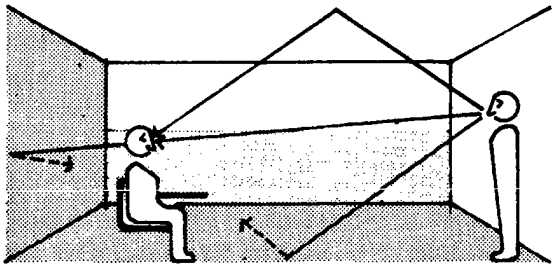


Figure 3-7 Sound Control In Classrooms

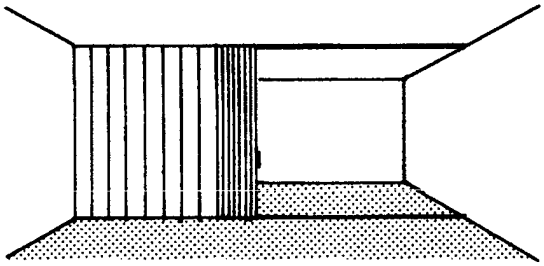
(i) Structural Considerations. Sounds should be isolated and/or reduced at their source, if possible. Machines producing high intensity sound can be enclosed with sound absorbing walls or shielded with sound absorbing material. Machines that produce high-intensity structure-borne sound should be acoustically isolated by special mounts.

(j) Mechanical Considerations. Air conditioning ducts may have to be treated to reduce noise transmission through the ducts. Space above ceilings, provided for distribution of ducts and other mechanical or electrical items, can allow excessive noise transmission from one space to another. Where such cases may occur, walls or partitions should extend up to the underside of the roof or floor above.

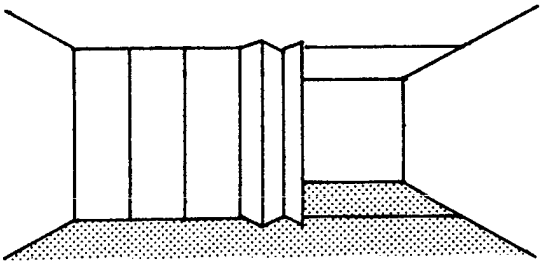
d. INTERIOR DETAILING. The attractiveness and overall usefulness of the building is directly affected by the interior detailing of the building design. Interior detailing will be developed in conjunction with an overall interior design so that items which are part of the building contract are coordinated with related furnishings and equipment to be procured separately by the installation. Interior wall systems, finish materials, signage and color applications must be carefully considered in this regard.

(1) Interior Wall Systems. Permanent walls should be held to a minimum necessary for structural and fire resistance purposes. Transverse walls where practical should be semi-permanent or movable. Employ movable walls in those spaces in which changes in function or class size are relatively frequent. Figure 3-8 shows some of the basic characteristics of the most common types of movable and semi-permanent interior wall systems. Table 3-2 provides data on the comparative cost and flexibility of wall systems. The designer must develop an accurate estimate of the frequency of functional change in a given space, and on that basis, select an appropriate interior wall system.

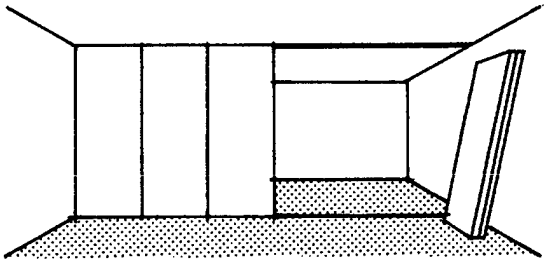
3-4 BUILDING DESIGN (cont'd)



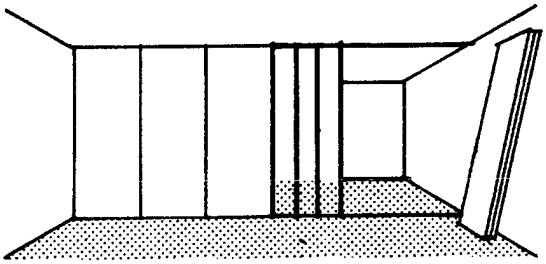
Operable Accordion Wall



Operable Folding Panel Wall



Portable Panel



Movable Stud and Facing Panel Wall

Figure 3-8 Changeable Wall Systems

Table 3-2 Comparative Cost and Flexibility of Wall Systems

PARTITION TYPE	Relative Cost	CHANGE FREQUENCY			
		Hourly	Daily	Monthly	Yearly
Fixed (non-load bearing) 6" Concrete Block or 5" Wood Stud & Plaster	1	No	No	No	Yes
Movable	1.8	No	No	Possible	Yes
Accordion	2.6	Yes	Yes	Yes	Yes
Portable	3.2	No	Possible	Yes	Yes
Folding Panel	5.4	Yes	Yes	Yes	Yes

3-4 BUILDING DESIGN (cont'd)

(2) Doorways. Doorways to instructional spaces should be recessed where possible, and open in the direction of exit as shown in Figure 3-9. This eliminates doors which may open into and impede traffic flows, however, sufficient clearances must be provided so that persons in wheelchairs can reach and pull the door open. Frequently used doors to habitable spaces (including toilet rooms) should have wire or tempered glass vision panels to allow users to see persons approaching the door from the opposite direction.

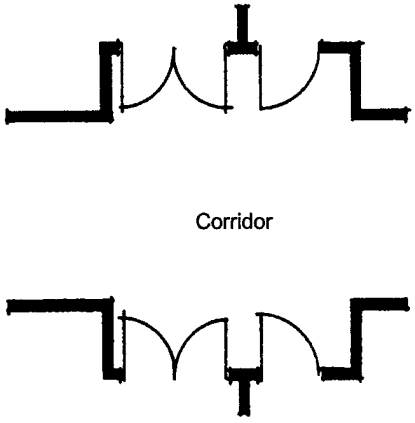


Figure 3-9 Recessed Room Exit

(3) Finish Materials. Interior finishes must be appropriate for the design function of the building and spaces. Selection of materials should be based on low maintenance qualities considering the anticipated use, life cost impact, fire and other safety requirements. Floor coverings should be easily maintained, durable and non-allergenic. They should contribute to sound control and provide a comfortable work surface. Unless otherwise specified, wall-to-wall carpeting should be provided in most areas except corridors, shops, toilets, storage areas, laboratories and vending areas. The color, texture and pattern of materials should complement the overall building design. Native (local) materials should be used to the greatest extent practicable. Long-life materials such as stones, tiles, woods, plastics and vinyls should be selected to provide attractive colors, textures and patterns that will not quickly become outdated. Painted surfaces and patterns are relatively easy and inexpensive to refurbish and can be kept fresh and up-to-date in appearance. Interior finishes must conform to the flame spread and smoke development standards contained in DoD Manual 4270.1-M and NFPA 101.

(4) Color. Use of color in Army facilities is limited to a practical number selected from Federal Standard 595A, Colors. General guidance for color selection is provided in TM 5-807-7, Colors for Buildings. Color should be used to stimulate human physical and emotional reactions and to enhance

3-4 BUILDING DESIGN (cont'd)

the overall functionality of the building. Use soft colors in study areas and consider brighter base colors and accents in casual seeing spaces. In critical seeing areas, glare, brilliant colors and great brightness differences, both in the lighting system and in the color of walls, floors, furnishings and equipment, should be avoided.

(5) Signage. Signage shall be designed as an overall building and site system and procured as part of the building construction. The system must be coordinated with signage required in conjunction with provisions for handicapped persons. Economy, ease of procurement and installation, and standardization of application are important considerations. The system should inhibit vandalism, but be flexible enough to enable the addition or deletion of information. The use of symbols instead of words is recommended. Where words are required, use a letterform such as Helvetica Medium, or other suitable letterforms. Letter sizes are designated by the height of the capital letters. Typical uses are 1 inch for locator signs, and 2 inches for directional and identification signs (and any signs where background lines are 3 inches apart). Signs should be located as close to eye-level as possible and be illuminated to provide adequate comprehension, either by room lighting or by special sign lighting avoiding reflection and glare. The building signage system should incorporate the types of signs described under the following headings:

(a) Facility Identifier Sign. This sign should be located in conjunction with the main entrance, oriented toward exterior pedestrian and vehicular traffic. It should identify the building number and the facility function (e.g., Education Center, etc.) and also indicate the hours of operation. Size of lettering and the exact location of the signs should be determined in each individual case in relation to the architectural design and local Facilities Engineer policy.

(b) Activity Locator Sign. This sign should be positioned in a prominent place for use upon entering the building and on each floor of a multi-story building. It must identify and locate building spaces, key activities and personnel and show emergency exits. The sign should also provide a description and/or plan of features for the physically handicapped.

(c) Identification Signs. These signs must identify restrictions, selected spaces, activities and personnel, and also reserved facilities such as for the physically handicapped. The most direct and economical way is by the use of symbols or pictographs. Use sign panels, approximately 6 inches square, for most identification purposes (toilets, phones, housekeeping closets, stairs, handicapped facilities, etc.) Use sign panels, approximately 12 inches square, for prohibitory signs (no entry, no smoking, etc.). When words and numbers are required as part of an individual space identification, use sign panels approximately 3 inches by 24 inches wall mounted next to doors on the side opposite the door hinge. A letterform approximately 2 inches in height, black on white where numbers are required and white on black where words are required, is recommended. The number of 3 inch x 24 inch sign panels for each space will depend upon how much information must be displayed. A symbol sign and a word-number sign are both shown in Figure 3-10.

Figure 3-10 Identification Signs

(d) Directional Signs. These signs can make use of the same sign panels as recommended under Identification Signs, using a black arrow in white panel above the white on black word panels as shown in Figure 3-11.

Figure 3-11 Directional Sign

(e) Notice Boards. Notice Boards help control clutter and can readily accommodate changing information pertaining to instruction schedules, text requirements, etc. They should be used adjacent to entries into individual shops, lecture rooms, seminar and classrooms, and elsewhere as appropriate. A general notice board should be located in the information registration area and in the student lounge. Simple notice boards can be created by providing a 3 foot to 5 foot wide field of a solid base color surmounted at the 6 1/2 foot level by a 6 inch white board with the word "Notices" in a 4 inch black letterform (such as Helvetica Medium). One or two narrow tack strips at the 6 foot and 4 foot levels should be provided as required for thumbtacking notices.

(6) Graphics. While mainly decorative, graphics may frequently incorporate floor numbers, directional indicators, safety markings, Army insignia, and so on. When professionally done, they can be most effective in livening up spaces and producing interest such as in large rooms or circulation spaces.

3-5 RELATED FURNISHINGS AND EQUIPMENT

Final selection of equipment and furnishings will be based on the items identified and data developed during the planning and programing process discussed in paragraph 2-6. During concept and final design, previous requirements and data must be reviewed and coordinated again with the installation. Data must then be updated using the *latest* mandatory source catalogs, and taking into account the pertinent selection factors and procurement support required.

a. SELECTION FACTORS.

(1) Appearance. Furniture is an integral part of the overall building design and must be closely coordinated with the selection of building colors and finish materials for consistency in appearance and quality. Clear relationship between the furnishings finish schedule and the building finish materials schedule should be evident. Similar attention should be given to the selection of equipment.

(2) Durability, Comfort, and Safety. Furnishings and equipment must be carefully selected to insure that the types chosen conform to standards of durability, comfort and safety appropriate for the uses they will receive. Being generally mobile, furniture and equipment items are subject to handling. Parts that receive the most wear should be replaceable, and finishes should sustain regular cleaning. Colors, textures, sizes, proportions, shapes and reflections are important comfort factors that should be considered. Furniture and equipment must withstand loading conditions without damage. Edges and surfaces should be smooth and rounded. Materials must be flame-retardant.

(3) Mobility and Interchangeability. Most furniture and equipment items should not be of a scale which would require more than two persons to relocate them, or be so complicated as to require an undue amount of time to assemble or disassemble. Whenever possible, choose multi-purpose furnishings and equipment which are suitable for a variety of needs and activities. Stackable and foldable items should be considered for reducing bulkiness in storage and transport where such requirements exist.

b. PROCUREMENT SUPPORT. Separate layouts and schedules will be developed to distinguish items which must be procured by the installation separately. Drawings and supporting data will be sufficient to facilitate procurement, and be in a format that can be readily understood by installation personnel who will be responsible for component placement and utilization after delivery. Placement plans, catalog illustrations, material and color samples together with procurement lists, source data and cost estimates should be developed as appropriate to accomplish this objective.

c. DELIVERY AND PLACEMENT. Once the procurement support material is complete, procurement must be scheduled to assure delivery upon completion of construction, otherwise beneficial use of the facility may be delayed. This is the responsibility of the installation. Delivery and placement of the items are extremely important considerations and should be *carefully managed* by the installation. Without such control, it will be difficult to assure quality, and execution of interior design intentions.

3-6 PROVISION OF USER INFORMATION

Records required upon completion of building projects are delineated in AR 415-10. Requirements for additional user information are established in ER 1110-345-700, Design Analysis. Design features which facilitate or aid functionality, housekeeping, etc., must be described and instructions prepared to supplement project completion records. The objective is to *identify how to best utilize the facility design* in a way that facilitates understanding by ACES Center personnel. The following outline indicates types of information that should be developed for this purpose.

a. SPECIAL CONSIDERATIONS.

(1) Barrier-free design features for both handicapped and able-bodied persons.

(2) Energy conservation features.

(3) Occupational safety and health provisions.

(4) Pollution control.

b. SITE DESIGN.

(1) Utility service system.

(2) Landscape features.

c. BUILDING DESIGN.

(1) Functional features of space organization.

(2) Floor load capacities and limitations.

(3) Space flexibility and multi-use provisions.

(4) Viewing positions and settings provided to enhance perception of design qualities and concepts.

(5) Protective construction features for wind resistance, seismic events and fallout.

(6) Sound and vibration controls.

(7) Features of environmental control system; HVAC, lighting, communications, etc.

(8) Fire protection system; detection alarm systems, evacuation routes, resistive construction and extinguishment systems.

3-6 PROVISION OF USER INFORMATION (cont'd)

(9) Security features; keying diagram, protective lighting, etc.

(10) Housekeeping and services supply, trash removal, storage, relamping, equipment repair, postal and engineer service, etc.

(11) Finish materials maintenance.

d. EQUIPMENT AND FURNITURE.

(1) Placement and flexibility.

(2) Storage and maintenance.

4-1 GENERAL

This chapter describes individual staff, academic, vocational training and support spaces needed to accommodate the typical functions of ACES Centers. Functional uses and adjacency relationships are described; occupant loads and space allocations are identified; and typical functional layouts are provided. Space allocations and layouts are based on 5-foot modular dimensioning discussed in Chapter 3 under Functional Layout. At the end of the chapter is a summary of environmental support criteria applicable to each space.

4-2 STAFF SPACES

Staff spaces include offices for the director, administrators, clerks, typists, registrar and counselors.

a. DIRECTOR'S OFFICE

Use	For the Director who oversees the ACES Center operation and holds frequent conferences with staff and visitors.
Occupant Load	1 staff
Space allocation	200 NASF
Adjacency relationships	Locate adjacent to Clerks, Typists and Administrators with indirect but unobstructed access to Counselors.
Layout	See Figure 4-1.

1. Director's Desk and Chair
2. Bookcase credenza
3. File cabinet
4. Visitor chair

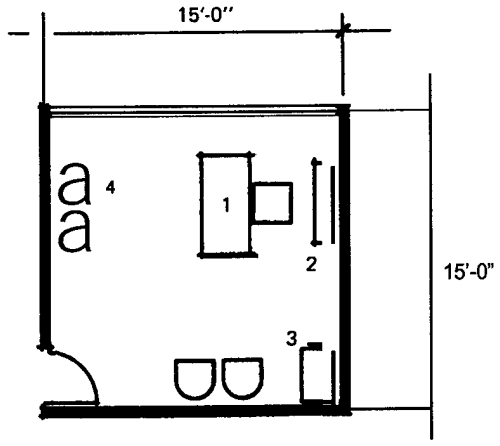


Figure 4-1 Director's Office

4-2 STAFF SPACES (cont'd)

b. ADMINISTRATOR OFFICES

Use	For Administrators who oversee various segments of the instructional program and hold frequent conferences with contracted instructors and staff.
Occupant load	1 staff per office
Space allocation	Offices 150 NASF per administrator
Adjacency relationships	Locate Administrators near the Director's Office
Layout	See Figure 4-2

1. Administrator's desk and chair
2. Bookcase or credenza
3. File cabinet
4. Visitor chair
5. Chalk/tack surface

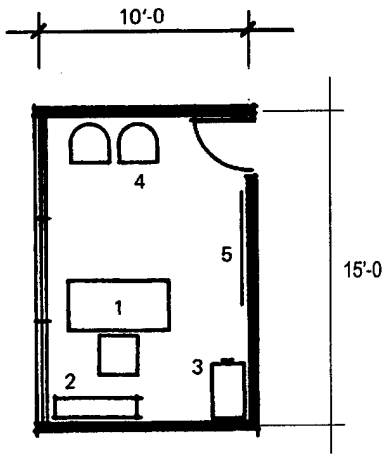


Figure 4-2 Administrator's Office

4-2 STAFF SPACES (cont'd)

c. INFORMATION/REGISTRATION/CLERK/TYPIST SPACE

Use	For Clerks who assist in administrative matters such as procurement, funds control, and in keeping of records; for Typists who provide typing and secretarial services for the entire staff; and for the Registrar who provides registration and information services. A contiguous space is required for visitor/student information. Also a separate space is required for storage of office forms and equipment.	
Occupant load	1 staff per office	
Space allocation	Offices	100 NASF per Clerk 75 NASF per Typist
	Registrar	100 NASF
	Information/Reg.	150 SF (min)
	Storage	75 SF (min)
Adjacency relationships	Locate Clerk/Typist spaces adjacent to Director/Administrator Offices. Locate Registrar and Information spaces adjacent to the main entrance for visitor convenience and visual control. Storage should be adjacent although it may be segmented to other parts of the facility where needs for this type of storage exist. Easy access should also be available to Training Aids Preparation and the Receiving Room.	
Layout	See Figure 4-3.	

4-2 STAFF SPACES (cont'd)

1. Typist Desk and Chair
2. Typing Credenza
3. File Cabinet
4. Bookcase
5. Clerk's Desk and Chair
6. Visitor Chair
7. Registrar's Desk and Chair
8. Counter w/computer terminal or file
9. Counter Chairs
10. Tack surface or Notice Board
11. Display and Trophy Cabinet
12. Shelving

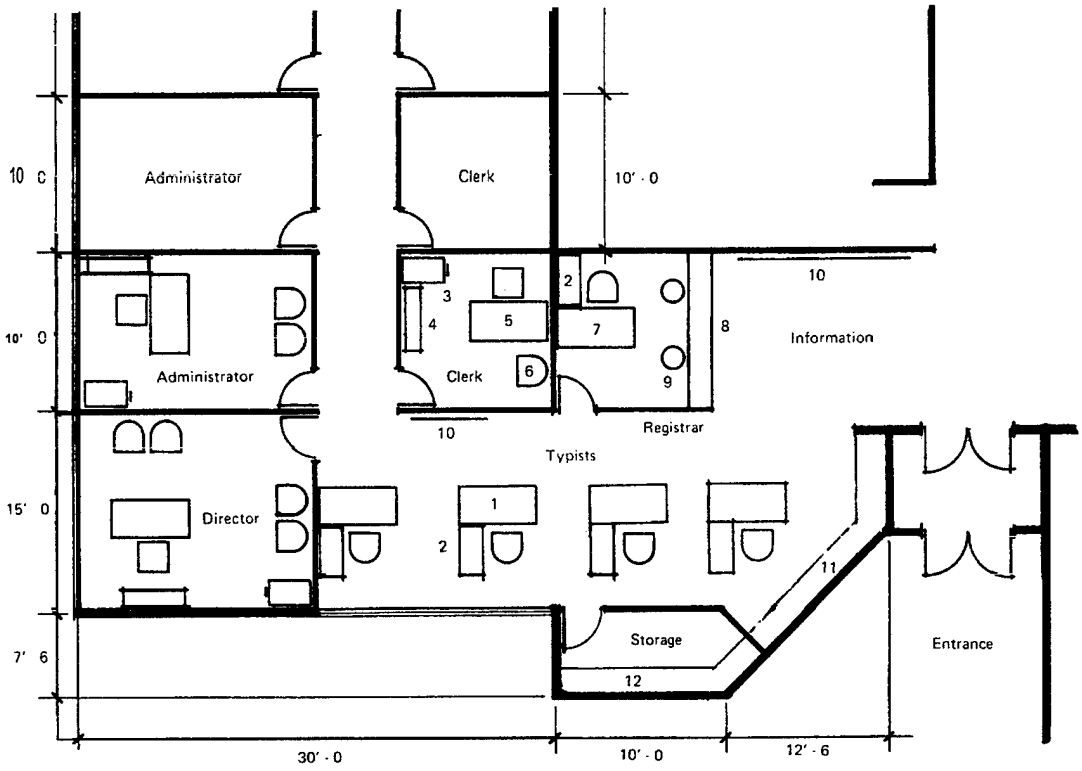


Figure 4-3 Information/Registration/Clerk/Typist Space

4-2 STAFF SPACES (cont'd)

d. COUNSELOR OFFICES

Use	For Counselors who assist personnel develop effective continuing education plans. A separate space for reference and conference is normally required.
Occupant load	1 staff per office
Space allocation	Offices 100 NASF per counselor; 1 to 10 75 NASF per counselor; 11 and above
Adjacency Relationships	Locate Counselors near the Information/Registration space with indirect but unobstructed access to the Director's Office. Reference room should be adjacent.
Layout	See Figure 4-4.

1. Counselor Desk and Chair
2. Bookcase
3. File Cabinet
4. Visitor Chair
5. Conference Table and Chairs
6. Reference/Display Shelving
7. Chalk/Tack Surface

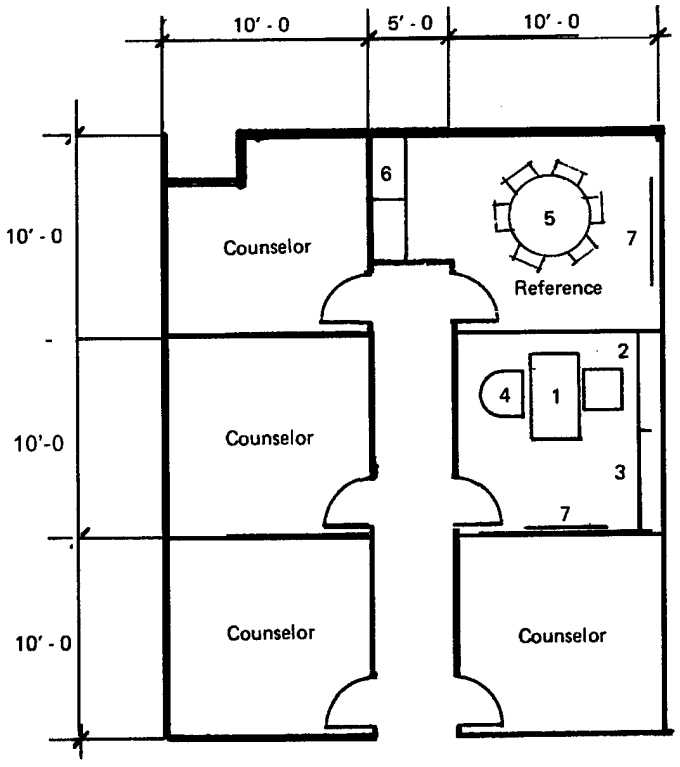


Figure 4-4 Counselor Offices

4-3 ACADEMIC SPACES

Academic spaces include classrooms, lecture rooms, seminar rooms, MOS library, self-paced instruction room, laboratories, testing room and rehearsal/recording studio.

a. CLASSROOM

Use	For general purpose classes.
Occupant load	24 students, 1 instructor
Space allocation	750 NASF
Adjacency Relationships	Locate together with other academic spaces.
Layout	See Figure 4-5.

1. TV Monitor
2. Instructor's Table and Chair
3. Student Table and Chair
4. Tack Board
5. Chalkboard

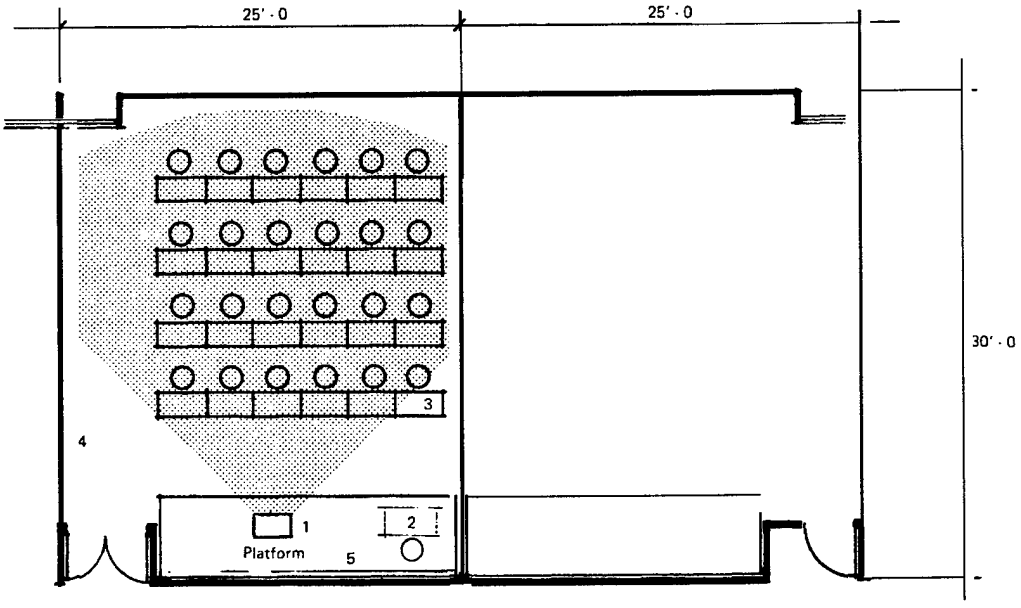


Figure 4-5 Classroom

4-3 ACADEMIC SPACES (cont'd)

b. LECTURE ROOM

Use	For lectures, testing and assemblies, educational and recreational motion pictures, and public meetings.
Occupant load	52 students, 1 instructor
Space allocation	1500 NASF
Adjacency relationships	Locate near classrooms and preferably near main entrance. Should be easily found by persons unfamiliar with the ACES Center. An adjacent lounge would be helpful in handling crowds entering and/or leaving, especially when used for recreation or public meetings.
Layout	See Figure 4-6

1. TV Monitor
2. Instructor's Table and Chair
3. Student Table and Chair
4. Tack Board
5. Chalkboard
6. Projection Screen

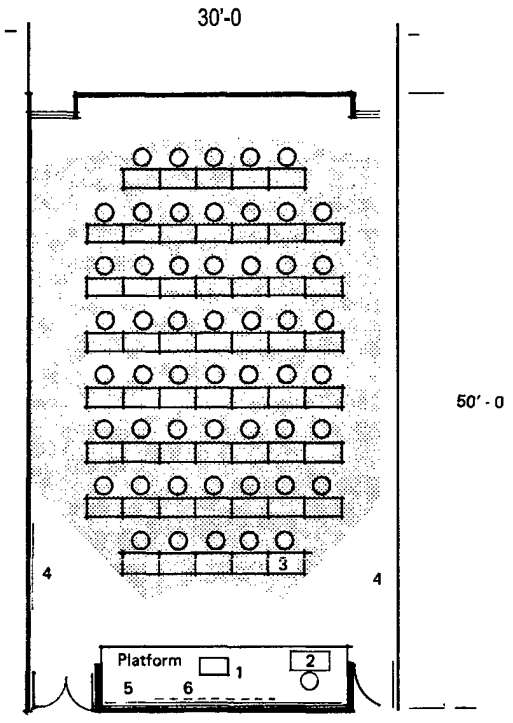


Figure 4-6 Lecture Room

4-3 ACADEMIC SPACES (cont'd)

c. SEMINAR ROOM

Use	For seminars, small classes and conferences.
Occupant load	12 students, 1 instructor
Space allocation	375 NASF
Adjacency relationships	Locate in proximity of other academic spaces. Maybe grouped or dispersed
Layout	See Figure 4-7

1. Seminar Table and Chairs
2. Tack Board
3. Chalkboard

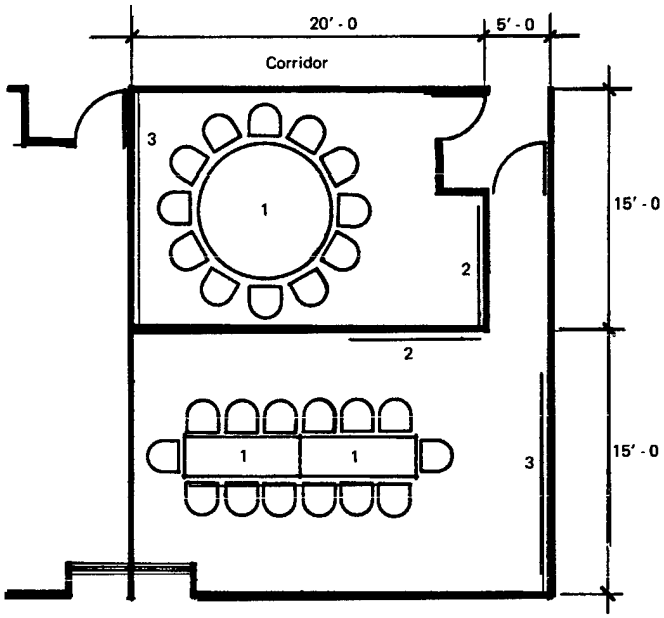


Figure 4-7 Seminar Rooms

4-3 ACADEMIC SPACES (cont'd)

d. MOS LIBRARY

Use	For storage and use of MOS-related material (approximately 10,000 volumes). The library is operated by staff on a schedule basis. In some cases, an MOS librarian may be authorized who would then also occupy the space.
Occupant load	8 students, 1 staff
Space allocation	750 NASF
Adjacency relationships	Adjacent with direct access to Self-Paced Instruction room. Central location to academic spaces is desirable.
Layout	See Figure 4-8

1. Staff Desk and Chair
2. Reading Table and Chairs
3. Reading Carrel and Chair
4. Bookstack
5. Tack Board

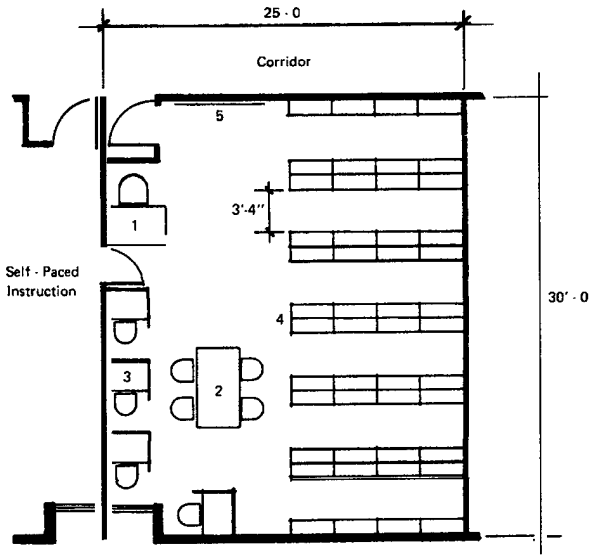


Figure 4-8 MOS Library

4-3 ACADEMIC SPACES (cont'd)

e. SELF-PACED INSTRUCTION

Use	For individual study of MOS-related and other educational material using AV aids such as audio cassettes with synchronized film strips, slides or videotapes.
Occupant load	19 students, 1 staff
Space allocation	750 NASF
Adjacency relationships	Locate adjacent to the MOS Library
Layout	See Figure 4-9

1. Staff Desk and Chair
2. AV Carrel and Chair
3. Reading Carrel and Chair
4. Acoustic Separation
5. Tack Board
6. Chalkboard

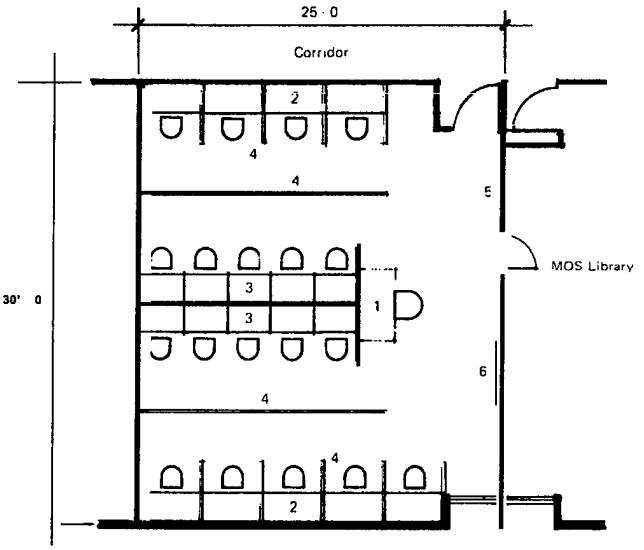


Figure 4-9 Self-Paced Instruction

4-3 ACADEMIC SPACES (cont'd)

f. LANGUAGE LABORATORY

Use	For language instruction where students listen to foreign language recordings, make their own recordings, practice speaking and carry out exercises. Separate spaces are required for storage and taping.
Occupational load	21 students, 1 instructor
Space allocation	Laboratory 600 SF Storage 95 SF Taping 55 SF Total 750 NASF
Adjacency relationships	Locate in proximity of other academic spaces. Rooms for taping and storage should open directly into laboratory.
Layout	See Figure 4-10

1. Instructor's Desk (with TV Monitor) and Chair
2. AV Carrel (with Division Panel) and Chair
3. Tack Board
4. Chalkboard
5. Projection Screen
6. Tape Storage
7. Shelving
8. Table and Chair

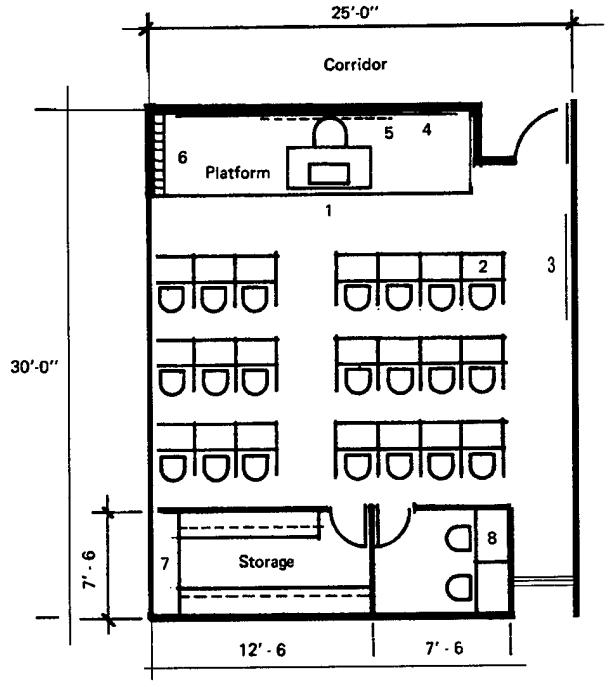


Figure 4-10 Language Laboratory

4-3 ACADEMIC SPACES (cont'd)

g. SCIENCE LABORATORY

Use	For instruction and experimentation in physics, biology and chemistry. Separate spaces are required for special projects, preparation of materials, and storage.
Occupant load	24 students, 1 instructor
Space allocation	Laboratory 1,050 SF Special Projects 225 SF Preparation 125 SF Storage 100 SF Total 1,500 NASF
Adjacency relationships	Locate in proximity of other academic spaces. Rooms for special projects, preparation, and storage should open directly into the laboratory.
Layout	See Figure 4-11

1. Work Counter w/Cabinet Below
2. Sink
3. Tack Board
4. Chalkboard
5. Peg Board
6. Refrigerator Below
7. Electric Range
8. Shelving
9. Table w/Cabinet Below
10. Service Island
11. Projection Screen
12. Microscope Cabinet
13. Safety Cabinet
14. Re-agent Cabinet
15. Fume Hood
16. Cabinet

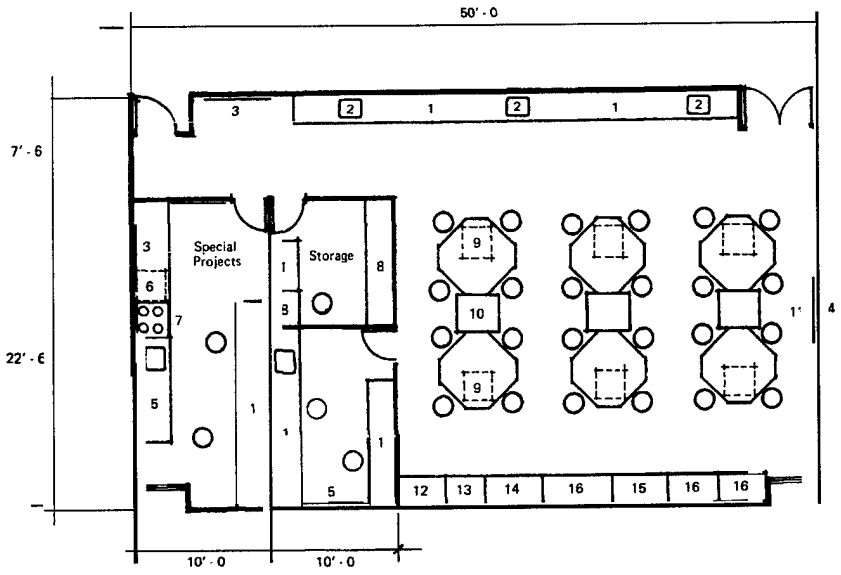


Figure 4-11 Science Laboratory

4-3 ACADEMIC SPACES (cont'd)

h. TESTING ROOM

Use	For testing and general purpose classes. Should be divisible into two classroom spaces. Separate spaces are required for observation and grading of examinations, and storage of extra tables and chairs required for classroom use.
Occupant load	35 students, 2 instructors for testing 48 students, 2 instructors for classes
Space allocation	Testing Room 1,625 SF Observation/Evaluation 150 SF Secure storage 55 SF Furniture storage 75 SF Total 1,905 NASF
Adjacency relationships	Locate near to classrooms and lecture room. Spaces for observation and storage should open directly into the testing room.
Layout	See Figure 4-12

1. Staff Desk and Chair
2. Cabinet
3. Files
4. Student Table and Chair
5. Stacking Chairs on Dolly
6. Folding Tables on Dolly
7. Tack Board
8. Chalkboard
9. Folding Divider Wall
10. Observation Windows
11. Shelving

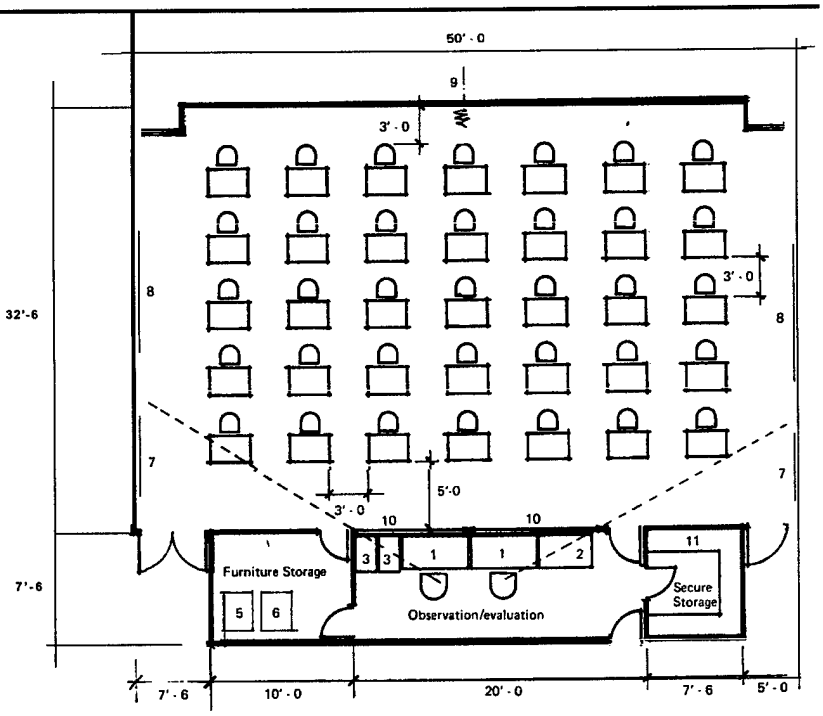


Figure 4-12 Testing Room

4-3 ACADEMIC SPACES (cont'd)

i. REHEARSAL/RECORDING STUDIO

Use	For rehearsals of lectures and demonstrations as well as for taping lectures for video presentation. May also be used for seminars.
Occupant load	6 persons
Space allocation	375 NASF
Adjacency relationships	Locate centrally to the academic area and near to lecture and seminar areas.
Layout	See Figure 4-13

1. Instructor's Table (or lecturn) with AV Controls
2. TV Monitor and Recorder
3. Tack Board
4. Chalkboard
5. Projection Screen
6. Projector/TV Camera
7. Table and Chair
8. Sound Lock Door

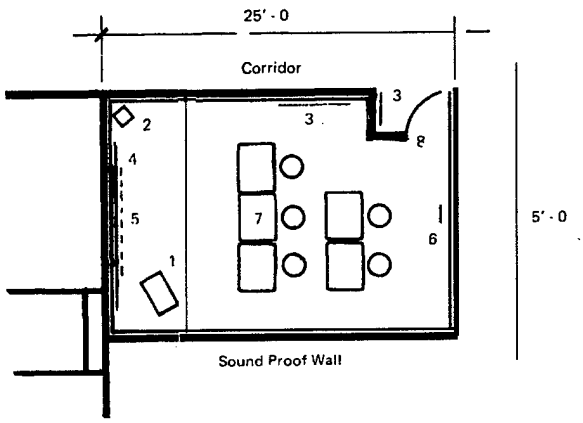


Figure 4-13 Rehearsal/Recording Studio

4-4 VOCATIONAL TRAINING SPACES

Vocational training spaces include shops for the following types of training:

Heating/Refrigeration/Air Conditioning

Construction Electrician

Communications/Industrial Electronics

Masonry

Carpentry

Plumbing

Diesel Mechanics

Auto Mechanics

Welding

Auto Body Repair

Small Engine Repair

Other courses may be offered, and each building project should reflect the specific requirements of the local program. Also, layouts must be verified by the using installation to assure that they conform to current programs and technologies. Laboratory ceiling heights should generally provide 16' minimum clearance, and each laboratory should have access to an outside service area. Vocational training shops require ample storage. The areas allocated to storage in this guide may be revised if necessary.

4-4 VOCATIONAL TRAINING SPACES (cont'd)

a. HEATING/REFRIGERATION/AIR CONDITIONING SHOP

Use	For lectures, demonstrations and laboratory experimentation with heating, air-conditioning and refrigeration units.
Occupant load	20 persons
Space allocation	2200 NASF
Adjacency relationships	Locate near to Plumbing Shop and Construction Electrician Shop with personnel access to exterior.
Layout	See Figure 4-14

b. CONSTRUCTION ELECTRICIAN SHOP

Use	For lectures, demonstrations and laboratory experimentation with electrical wiring systems related to building construction. Separate spaces are required for secure storage of tools and supply parts and for conferences.	
Occupant load	20 persons	
Space allocation	Shop	2,000 SF
	Tool Storage	150 SF
	Supply Parts	150 SF
	Conference	150 SF
	Total	2,450 NASF
Adjacency relationships	Locate near to Communications/Industrial Electronics Shop and the Heating/Refrigeration/Air Conditioning Shop with personnel and service access to exterior service area. Locate tool storage, supply parts, and conference rooms near entrance and open directly into shop.	
Layout	See Figure 4-15	

4-4 VOCATIONAL TRAINING SPACES (cont'd)

1. Test Stand
2. Combined Forced Air & Hydronic Heating Training Units
3. Heating Test Equipment Package
4. Gas Fired Forced Air Control Board
5. Oil Fired Forced Air Control Board
6. Automobile Air Conditioner Training Unit
7. Cooling Tower Build-up Unit
8. Automobile Air Conditioner Training Unit
9. Oil Burner Climate Control Trainer
10. Gas Burner Climate Control Trainer
11. Refrigeration and Air Conditioning Test Equipment Package
12. Medium Commercial Multiple Evaporator Build-up Unit
13. Medium Commercial-Forced Convection Evaporator-Open Type Compressor Build-up Unit
14. Medium Commercial-Forced Convection Evaporator-Semi-Hermetic
15. Commercial Freezer-Electric Defrost Build-up Unit
16. Light Commercial Freezer-Air Conditioner Build-up Unit
17. Medium Commercial Forced Convection Evaporator Build-up Unit
18. Light Commercial Forced Convection Evaporator Build-up Unit
19. Light Commercial-Gravity Evaporator Build-up Unit
20. Domestic Refrigeration Trainer Double Evaporation Build-up Unit
21. Air Conditioner Build-up Unit
22. Domestic Refrigeration Trainer Single Evaporator Build-up Unit
23. Industrial Refrigeration Trainer
24. Refrigeration and Air Conditioning Training Units
25. Single Phase Compressor Control Board
26. Refrigeration and Air Conditioning Training Units—Heat Pump Operation
27. Work Bench
28. Work Station
29. Table
30. Chalk/Tack Surfaces
31. Cabinet w/sink

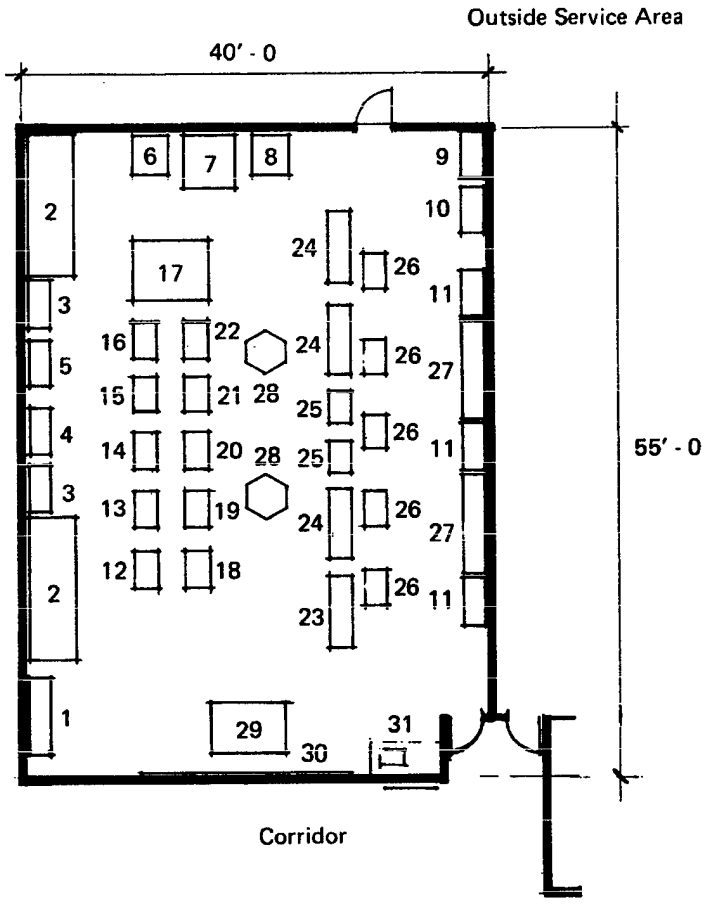


Figure 4-14 Heating/Refrigeration/Air Conditioning Shop

4-4 VOCATIONAL TRAINING SPACES (cont'd)

1. Residential Wiring Trainer
2. Metal bench
3. Electric Wiring Trainer
4. Electric Test Bench
5. Soldering Bench
6. Wall Assembly Unit
7. Motor Control Wiring Unit
8. AC Wiring and Lighting Simulator
9. Overhead Door
10. Divider Screens
11. Conference Table and Chairs
12. Chalkboard
13. Tack Board
14. Tool Storage Cabinet
15. Industrial Shelving

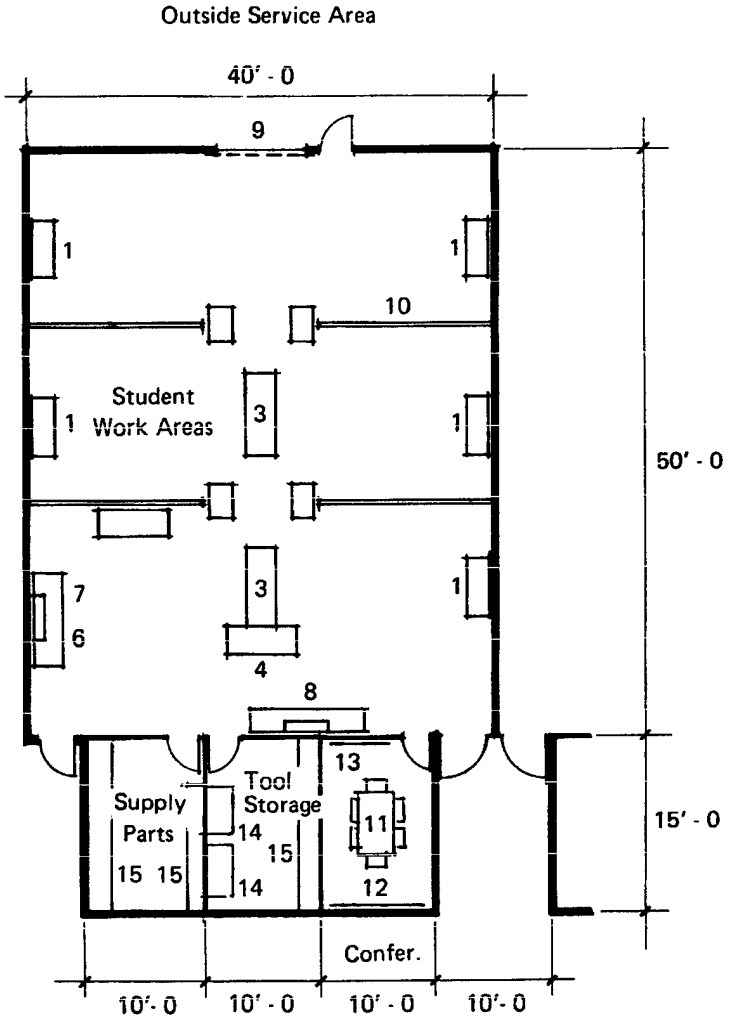


Figure 4-15 Construction Electrician Shop

4-4 VOCATIONAL TRAINING SPACES (cont'd)

c. COMMUNICATION/INDUSTRIAL ELECTRONICS SHOP

Use	For lectures, demonstrations and laboratory experimentation with basic communications, electrical and electronic systems, and motor machines. Separate spaces are required for secure storage of tools, general storage and for conferences.	
Occupant load	20 persons	
Space allocation	Shop	2,000 SF
	Tool Storage	150 SF
	General Storage	225 SF
	Conference	150 SF
	Total	2,525 SF
Adjacency relationships	Locate near Construction Electrician Shop with personnel and service access to exterior service area. Locate storage and conference rooms near entrance and open directly into shop.	
Layout	See Figure 4-16	

4-4 VOCATIONAL TRAINING SPACES (cont'd)

1. Electrical Benches
2. Basic Electricity Trainers
3. Electricity-Electronics Trainers
4. Power Tunnels
5. 5" V.I.Z. Oscilloscope
6. Electrical Wiring Tunnel
7. Security Alarm Trainer
8. AC Wiring and Lighting Simulator
9. Residential Wiring Trainer
10. Basic Studies of Transformers
11. Single Phase DC Machines
12. Three Phase Machines
13. Specialized Machines
14. Optional Accessories for Motors
15. Motor Control Units
16. Mobile Console
17. Tool Storage
18. Synchronizing Switch/Circuit Breakers.
19. Three Phase Synchronous Motor Starter
20. AC Three Phase Starter
21. AC Motor Starter
22. Overhead Door
23. Conference Table and Chairs
24. Chalkboard
25. Tack Board
26. Tool Storage Cabinet
27. Industrial Shelving

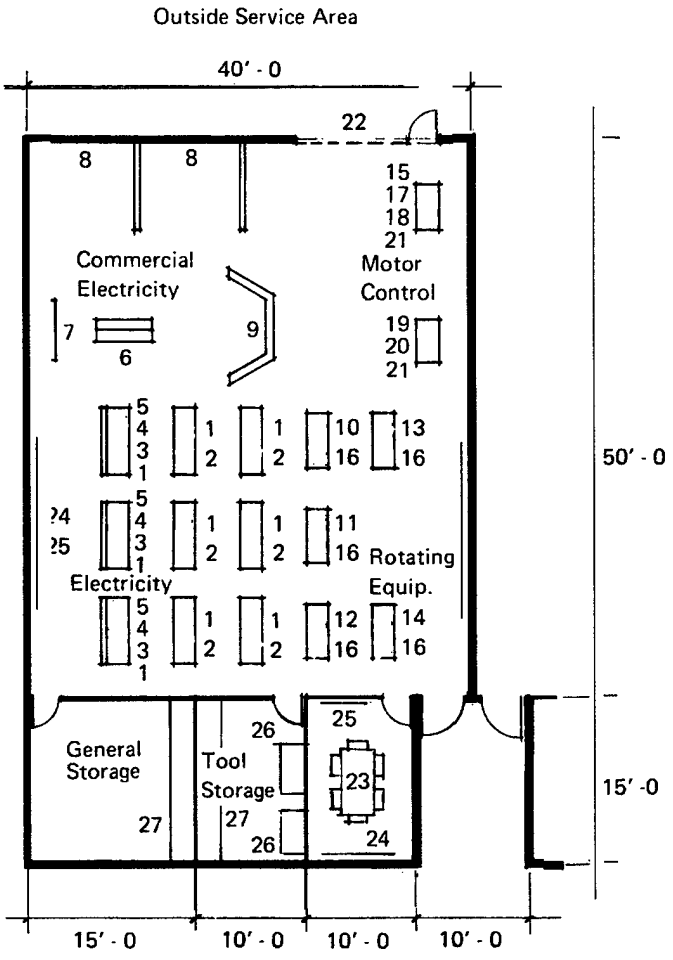


Figure 4-16 Communications/Industrial Electronic Shop

4-4 VOCATIONAL TRAINING SPACES (cont'd)

d. MASONRY SHOP

Use	For lectures, demonstrations and laboratory experience in masonry construction. Separate spaces are required for secure storage of tools, general storage, and for conferences.	
Occupant load	20 persons	
Space allocation	Shop	3,250 SF
	Tool Storage	375 SF
	General Storage	375 SF
	Conference	150 SF
	Total	4,150 NASF
Adjacency relationships	Locate in area of Carpentry, Plumbing and Heating/ Refrigeration/Air-Conditioning Shops with personnel and service access to exterior. Locate storage and conference rooms near entrance and open directly into shop.	
Layout	See Figure 4-17	

4-4 VOCATIONAL TRAINING SPACES (cont'd)

1. Mortar Box
2. Wheelbarrows
3. Brick and Tile Barrow
4. Utility Hand Truck
5. Concrete Mixers
6. Mortar Mixers
7. Overhead Door
8. Divider Screens
9. Conference Table and Chairs
10. Chalkboard
11. Tack Board
12. Tool Storage Cabinet
13. Industrial Shelving

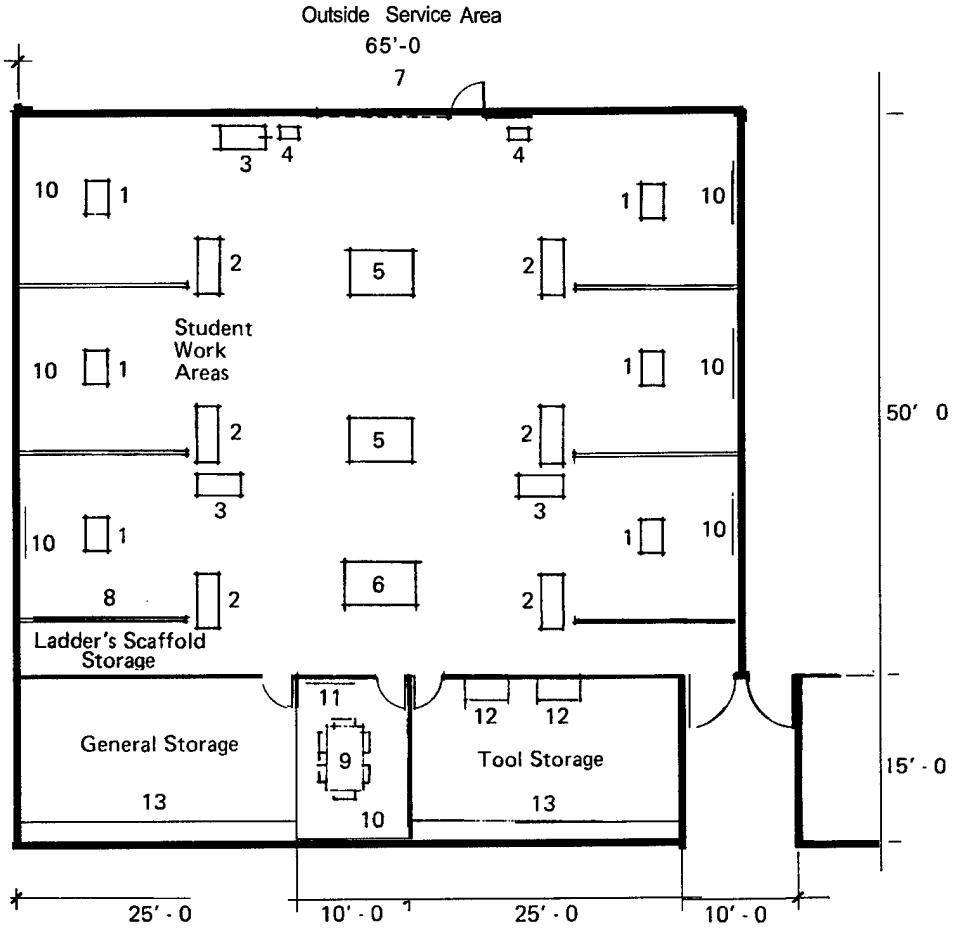


Figure 4-17 Masonry Shop

4-4 VOCATIONAL TRAINING SPACES (cont'd)

e. CARPENTRY SHOP

Use	For lectures, demonstrations and laboratory experience in rough and finish carpentry. Separate spaces are required for tool/supply storage, finish work, and conferences.	
Occupant load	20 persons	
Space allocation	Shop	4,000 SF
	Tool/Supply Storage	300 SF
	Finish room	225 SF
	Conference	150 SF
	Total	4,675 NASF
Adjacency relationships	Locate near Plumbing, Masonry and Heating/Refrigeration/Air-Conditioning Shops with personnel and service access to outside service area. Locate tool/supply, finish and conference rooms near entrance and open directly into shop.	
Layout	See Figure 4-18	

4-4 VOCATIONAL TRAINING SPACES (cont'd)

1. Work Bench
2. Tilting Arbor Saw
3. Long-bed Jointer
4. Four Station Work Bench
5. Drill Press
6. Panel Saw
7. Sliding Door Cabinets
8. Radial Saw
9. Lumber Rack
10. Overhead Door
11. Divider Screens
12. Conference Table and Chairs
13. Chalkboard
14. Tack Board
15. Cabinet with Sink
16. Table
17. Tool Storage Cabinet
18. Industrial Shelving

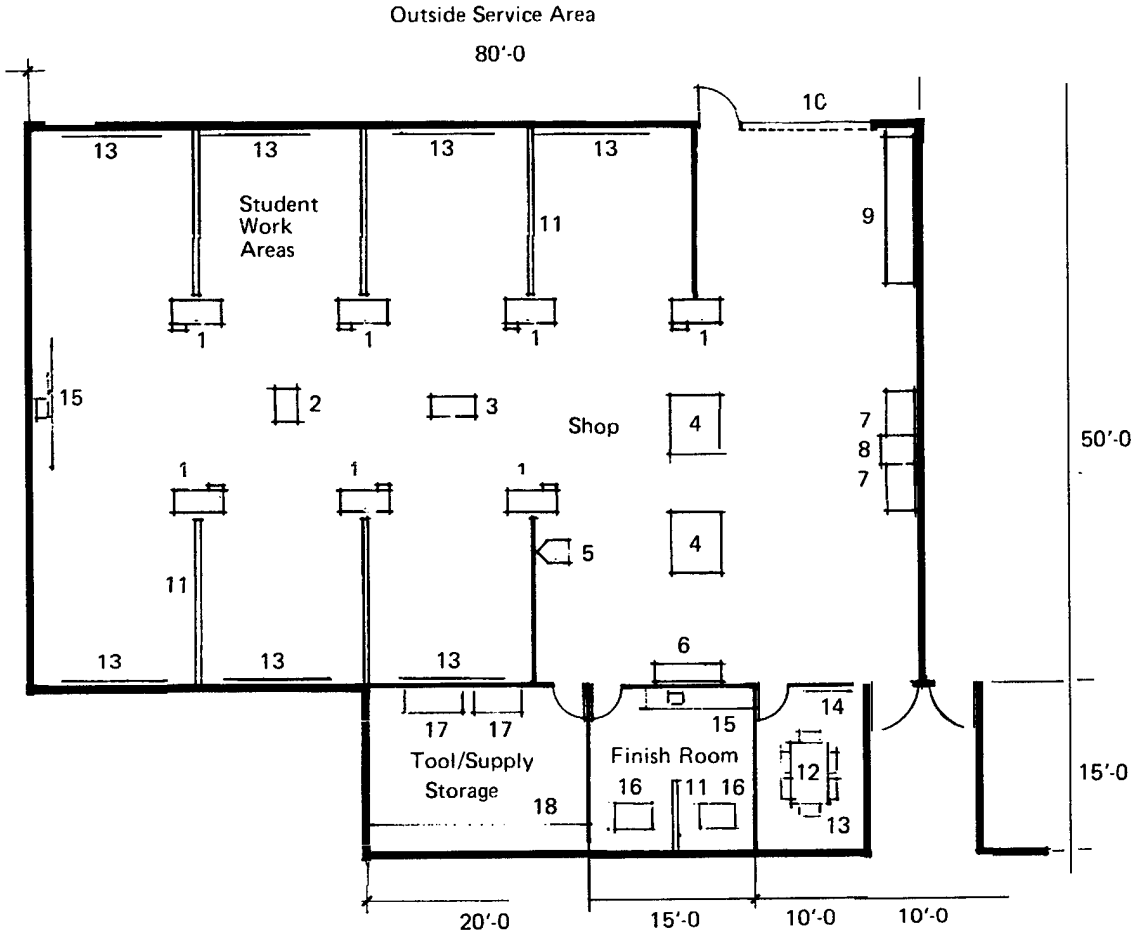


Figure 4-18 Carpentry Shop

4-4 VOCATIONAL TRAINING SPACES (cont'd)

f. PLUMBING SHOP

Use	For lectures, demonstrations and laboratory experience in plumbing. Separate spaces are required for secure storage of tools, general storage and for conferences.	
Occupant load	20 persons	
Space allocation	Shop	2,000 SF
	General Storage	150 SF
	Tool Storage	150 SF
	Conference	150 SF
	Total	2,450 NASF
Adjacency relationships	Locate near Carpentry and Heating/Refrigeration/Air-conditioning Shops with service access to outside service area. Locate general storage, tool and conference rooms near entrance and open directly into shop.	
Layout	See Figure 4-19	

4-4 VOCATIONAL TRAINING SPACES (cont'd)

1. Portable Tri-stand Vise
2. Metal Porta-bench
3. Pipe and Bolt Threading Machine
4. Adjustable Pipe Support
5. Parts Storage
6. Wall Assembly Unit
7. Box and Pan Brakes
8. Hand Operated Rollers
9. Metal and Scrap Rack
10. Overhead Door
11. Divider Screens
12. Conference Table and Chairs
13. Chalkboard
14. Tack Board
15. Cabinet w/sink
16. Tool Storage Cabinet
17. Industrial Shelving

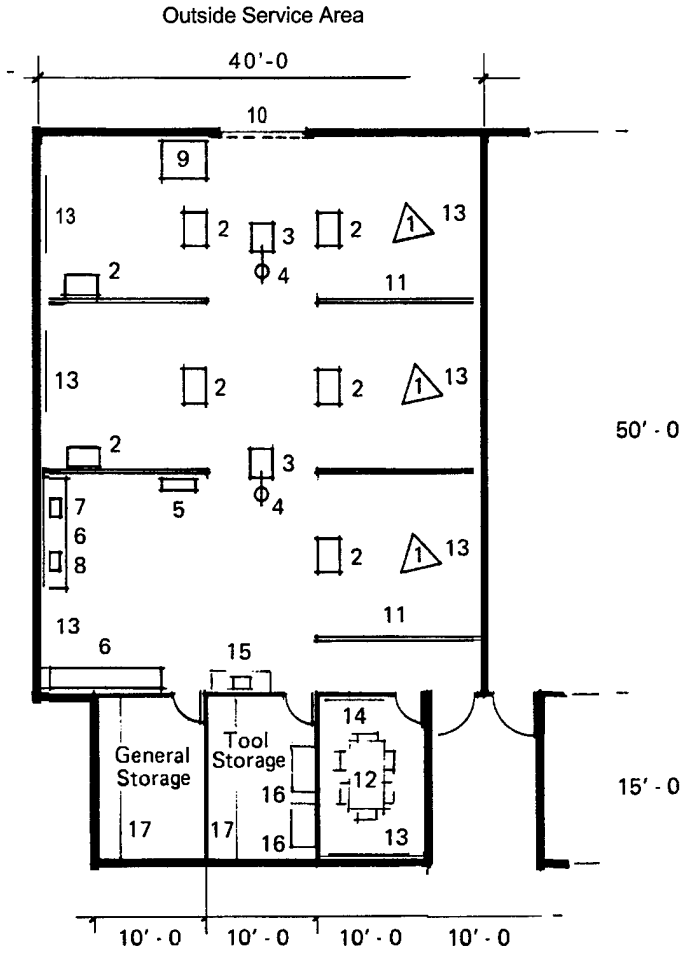


Figure 4-19 Plumbing Shop

4-4 VOCATIONAL TRAINING SPACES (cont'd)

g. DIESEL MECHANICS SHOP

Use	For lectures, demonstrations and laboratory experience in diesel mechanics. Separate spaces are required for storage of tools and for conferences.	
Occupant load	20 persons	
Space allocation	Shop	2,800 SF
	Tool Storage	225 SF
	Conference	150 SF
	Total	3,175 NASF
Adjacency relationships	Locate near Auto Mechanics and Plumbing Shops with service and personnel access to outside service area. Locate tool storage and conference rooms near entrance and open directly into shop.	
Layout	See Figure 4-20	

4-4 VOCATIONAL TRAINING SPACES (cont'd)

1. Engine Service Module
2. Instruction Module
3. Battery Service Module
4. Parts Module
5. Wet Cleaning Module
6. Liquid Fuel Module
7. Dynamometer Module
8. Dry Cleaning Module
9. Special Tool Module
10. Engine Work Stand
11. 2-station Work Bench
12. Engine Work Stand w/accessories
13. 7" Pedestal Grinder
14. 15" Drill Press
15. 25 Ton Arbor Press
16. Parts Washer
17. Steam Cleaner
18. 4-station Work Bench
19. Storage Cabinet
20. Wall Bench
21. Injector Floor Comparator
22. Bacharach Pump-Injector Test Package
23. Hydraulic Training Unit
24. Advanced Hydraulic Kit
25. Goggle Cabinet
26. File Cabinet/Reference Module
27. Tool Storage Cabinet
28. Hardware Cabinet
29. Industrial Shelving
30. Machinists' Vise
31. Overhead Door
32. Cabinet w/sink
33. Conference Table and Chairs
34. Chalkboard
35. Tack Board

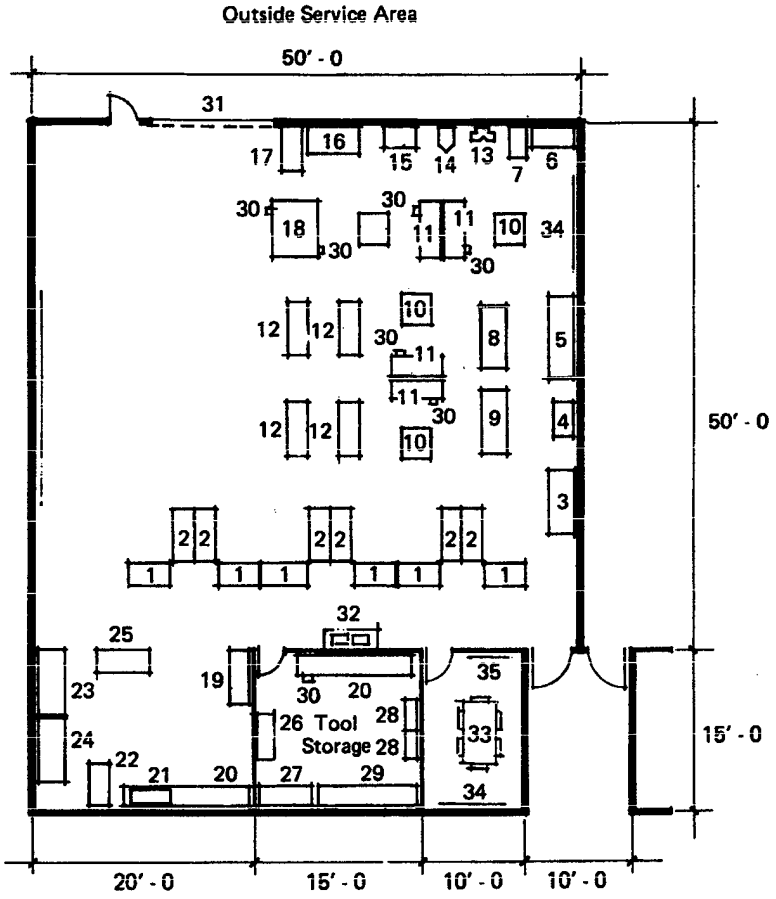


Figure 4-20 Diesel Mechanics Shop

4-4 VOCATIONAL TRAINING SPACES (cont'd)

h. AUTO MECHANICS SHOP

Use	For lectures, demonstrations and laboratory experience in auto mechanics. Separate spaces are required for general and tool storage and for conferences. Outside storage for approximately ten cars, fenced for security and screening, is also required.	
Occupant load	20 persons	
Space allocation	Shop	5,250 SF
	Tool Storage	225 SF
	General Storage	225 SF
	Conference	150 SF
	Total	5,850 NASF
	Outside Auto Storage 2000 SF (approximately)	
Adjacency relationships	Locate near Diesel Mechanics, Welding, and Plumbing Shops with personnel and multi-service accesses to outside service area and auto storage. Locate storage rooms and conference room near entrance and open directly into shop.	
Layout	See Figure 4-21	

4-4 VOCATIONAL TRAINING SPACES (cont'd)

1. Wheel Visual Balancer
2. Battery Charger
3. Tire Changer
4. Work Bench
5. 2 Ton Ball Bearing Trolley
6. Press — 40 ton
7. Work Bench
8. Mechanical Service Bay
9. Spark Plug Cleaner
10. Air Conditioner Tester
11. Armature Tester
12. Engine Analyzer
13. Infra-Red Co/HC Analyzer
14. Distributor Tester
15. Shop Desk
16. Auto Lift
17. Valve Grinding Shop
18. Brake Shop
19. 12" Grinder
20. Steam Cleaner
21. Engine Stand
22. 15" Drill Press with Motor
23. Parts Washer
24. Generator-Alternator-Regulator Test Bench
25. Bolt-Amp Tester
26. Battery-Starter Testers
27. Ignition Simulator
28. Goggle Cabinet
29. Tool Cabinet
30. Tool Storage Cabinet
31. Industrial Shelving
32. Storage Cabinets
33. Cabinet w/sink
34. Overhead Door
35. Conference Table and Chairs
36. Chalkboard
37 Tack Board

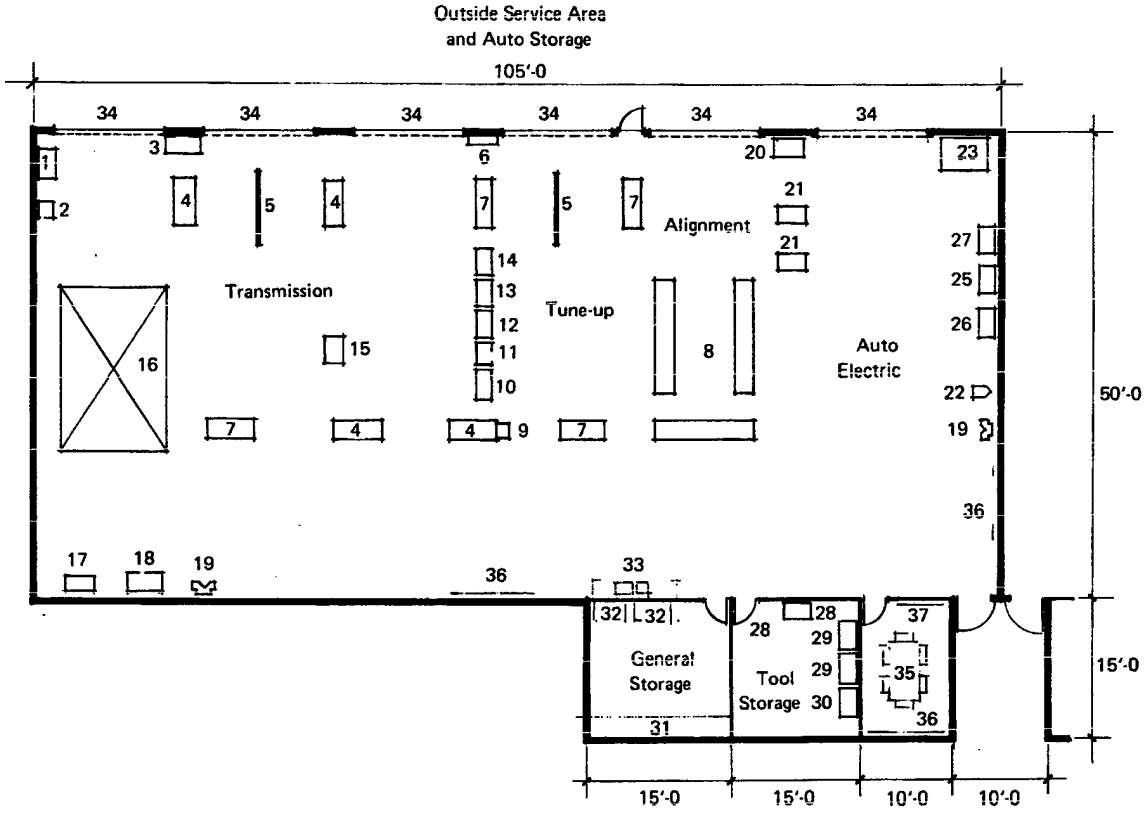


Figure 4-21 Auto Mechanics Shop

4-4 VOCATIONAL TRAINING SPACES (cont'd)

i. WELDING SHOP

Use	For lectures, demonstrations and laboratory experience with gas and arc welding equipment. Separate spaces are required for tool and general storage, for storing gas and oxygen safely, and for conferences. A small facility for outside scrap storage is also required.	
Occupant load	20 persons	
Space allocation	Shop	3,875 SF
	Tool Storage	150 SF
	General Storage	150 SF
	Conference	150 SF
	Gas and Oxygen Storage (2@ 75)	150 SF
	Total	4,475 NASF
Adjacency relationships	Locate near Auto Mechanics and Auto Body Repair Shops with personnel and service access to outside service area. Locate scrap storage adjacent within service area. Locate gas and oxygen storage in explosion-proof rooms having direct access to outside service area as well as to shop. Locate other rooms for storage and conference near main entrance and open directly into shop.	
Layout	See Figure 4-22	

4-4 VOCATIONAL TRAINING SPACES (cont'd)

1. Arc Welder
2. Arc Welding Bench
3. Two-station Gas Welding Bench
4. Pedestal Grinder
5. Steel Top Layout Table
6. TIG Welding Unit on Wheels
7. MIG-RID 3 Welding Unit
8. Arc Welder with Wheels
9. Anvil with Stand
10. Welding and Cutting Outfit
11. Bar Storage Racks
12. Spot Welder
13. Power Hacksaw
14. Four Station Metal Working Bench
15. Machinists' Vise
16. Work Bench
17. Welding Testing Center
18. Heat Treating Furnace
19. Drill Press
20. Overhead Door
21. Cabinet with sink
22. Tool Storage Cabinet
23. Industrial Shelving
24. Conference Table and Chairs
25. Chalkboard
26. Tack Board

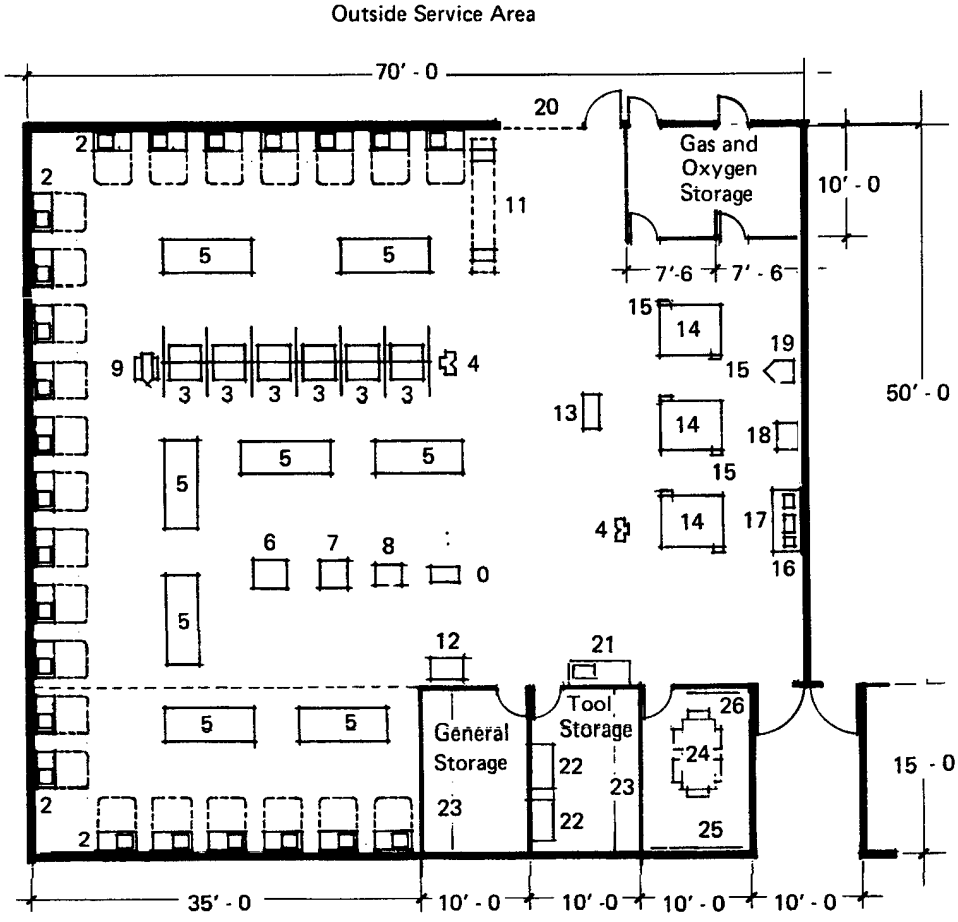


Figure 4-22 Welding Shop

4-4 VOCATIONAL TRAINING SPACES (cont'd)

j. AUTO BODY REPAIR SHOP

Use

For lectures, demonstrations and laboratory experience in auto body repair. Separate spaces are required for spray painting, for paint, tool and general storage, and for conferences. Outside storage for approximately ten cars and space for scrap storage is also required.

Occupant load

20 persons

Space allocation

Shop	3,650 SF
Spray Painting Room	600 SF
Paint Storage	75 SF
General Storage	450 SF
Tool Storage	150 SF
Conference	150 SF
Total	5,075 NASF

Outside Auto Storage 2000 SF (approximately)

Adjacency relationships

Locate near Welding Shop and Auto Mechanics Shop with personnel and multi-service accesses to outside service area. Outside auto and scrap storage areas should be adjacent. When provided with the Auto Mechanics Shop and/or Welding Shops, such areas should be centralized for combined use. Spray painting and paint storage should be located in separate, fire-proof rooms. The spray painting room should have direct service access to the outside service area. Locate rooms for general storage, tool storage and conference near entrance and open directly into shop.

Layout

See Figure 4-23

4-4 VOCATIONAL TRAINING SPACES (cont'd)

1. 15" Drill Press with Motor
2. Combination Buffer/Grinder
3. Hardware Cabinet
4. Work Bench
5. Spot Welder
6. Welding Package
7. Steam Cleaner/Washer
8. Auto Body and Frame Alignment System
9. Work Bench
10. Paint Cabinet
11. Infra-red Heater
12. Complete Professional Spray Outfit
13. Overhead Door
14. Cabinet with Sink
15. Tool Storage Cabinet
16. Industrial Shelving
17. Conference Table and Chairs
18. Chalkboard
19. Tack Board.

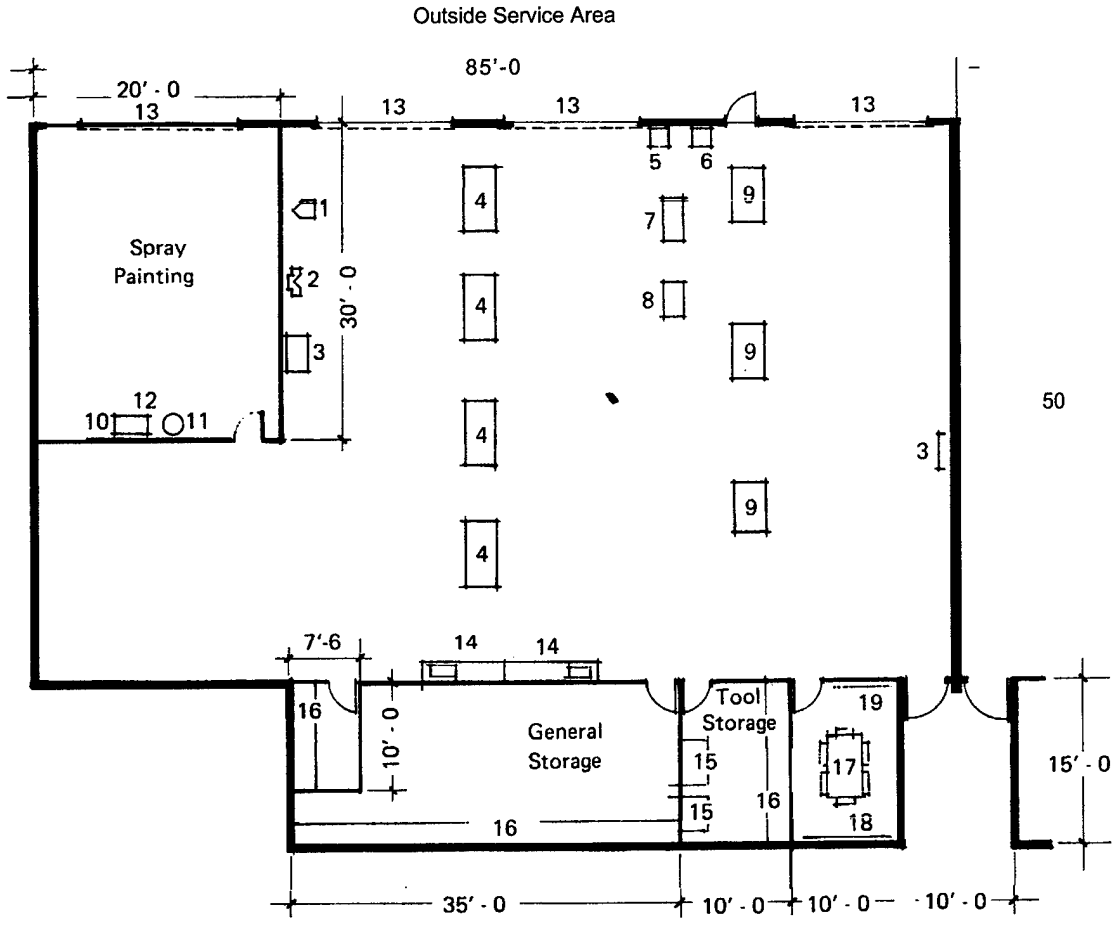


Figure 4-23 Auto Body Repair Shop

4-4 VOCATIONAL TRAINING SPACES (cont'd)

k. SMALL ENGINE REPAIR SHOP

Use	For lectures, demonstrations and laboratory experience in small engine repair. Separate spaces are required for tool and general storage, and for conferences.	
Occupant load	20 persons	
Space allocation	Shop	3,000 SF
	General Storage	375 SF
	Tool Storage	150 SF
	Conference	150 SF
	Total	3,675 NASF
Adjacency relationships	Locate near Heating/Refrigeration/Air-conditioning Shop and Communications/Industrial Electronics Shop with personnel and service access to outside service area. Locate rooms for general storage, tool storage and conference near entrance and open directly into shop.	
Layout	See Figure 4-24	

4-4 VOCATIONAL TRAINING SPACES (cont'd)

1. Portable Work Bench
2. Work Bench w/2 Mechanic's Vises
3. Swivel Engine Stand
4. Bench Mounted Holding Fixture
5. Bench Powerlab with tools (exhaust gas collection vent needed)
6. Portable Engine Hoist
7. Small Engine Technology Center
8. Power Mechanic Teaching System
9. Projection Screen
10. Chalk/tack Surface
11. Instructor Desk and Chair
12. File Cabinet
13. Student Chairs
14. Wall Bench Unit
15. Fuel and Refueling System
16. Parts Washer
17. Utility 15" Drill Press
18. Long Shaft Buffer-wire Wheel
19. Grinder with Stand
20. Outboard Motor Stand – Portable
21. Outboard Motor Stand
22. Outboard Motor Test Tank
23. Cart
24. Storage Cabinet
25. Tool Storage Cabinet
26. Industrial Shelving
27. Cabinet with Sink
28. Overhead Door
29. Conference Table and Chairs

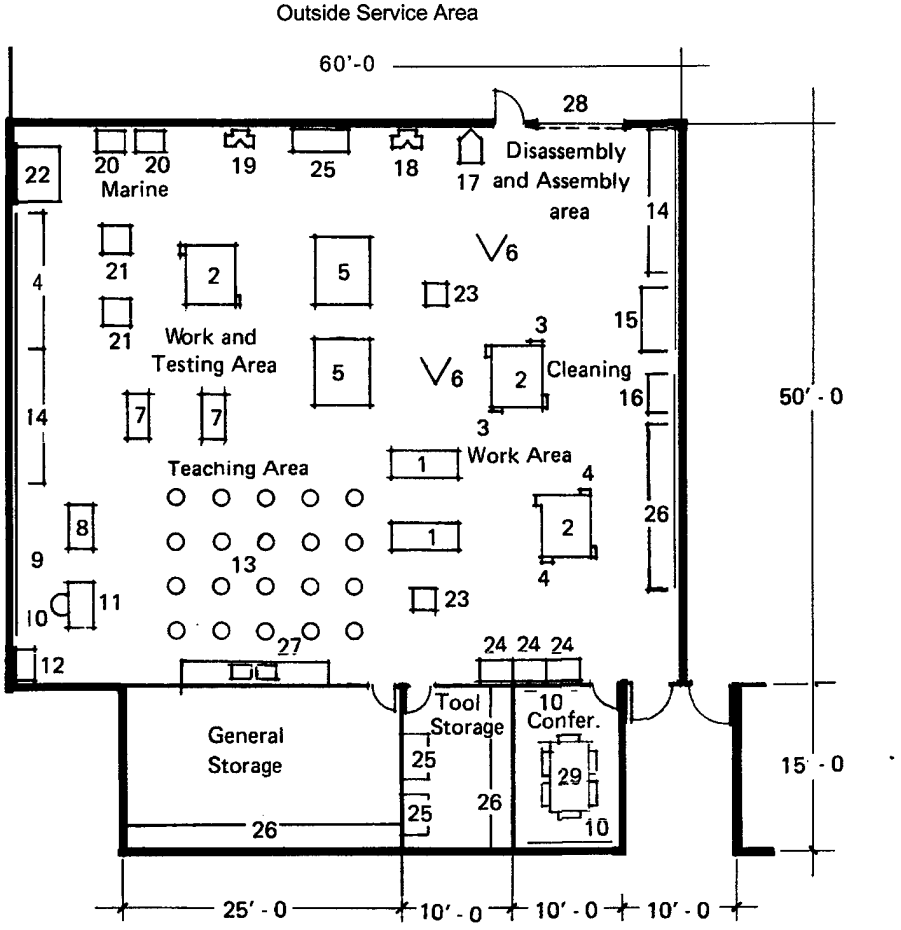


Figure 4-24 Small Engine Repair Shop

4-5 SUPPORT SPACES

Support spaces include staff and student lounges, vending area, training aids preparation, receiving and storage, toilets and janitor closet.

a. STAFF LOUNGE

Use	For informal meetings, coffee breaks, lunch and general relaxation.
Occupant load	6 persons (min)
Space allocation	1.5% of the combined NASF for academic and staff spaces; or 150 NASF (min)
Adjacency relationships	Locate near staff offices and adjacent to vending area.
Layout	See Figure 4-25

1. Armchair
2. Sofa
3. Low Table
4. Tack Surface
5. Table or Cabinet w/sink

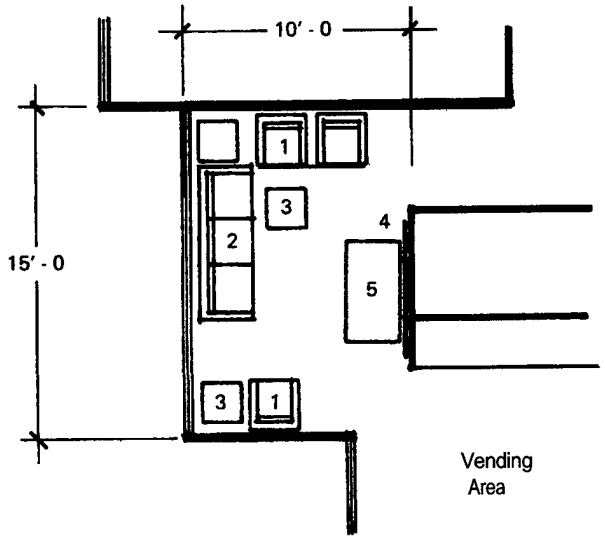


Figure 4-25 Staff Lounge

4-5 SUPPORT SPACES (cont'd)

b. STUDENT LOUNGE

Use	For relaxation during class breaks, lunch hour and unscheduled class time.
Occupant load	18 persons (min)
Space allocation	5.5% of the combined NASF for academic and staff spaces; or 400 NASF (min)
Adjacency relationships	Locate adjacent to the vending area to permit food consumption and alleviate crowding of the vending area during periods of heavy usage. Also locate near the main entrance for convenience of visitors and for visibility. Lounge space may also be dispersed throughout the building. This may be more convenient than a centrally located lounge, and could provide visual interest to the circulation area.
Layout	See Figure 4-26

1. Arm Chair
2. Low Table
3. Table and Chairs
4. Tack Surface

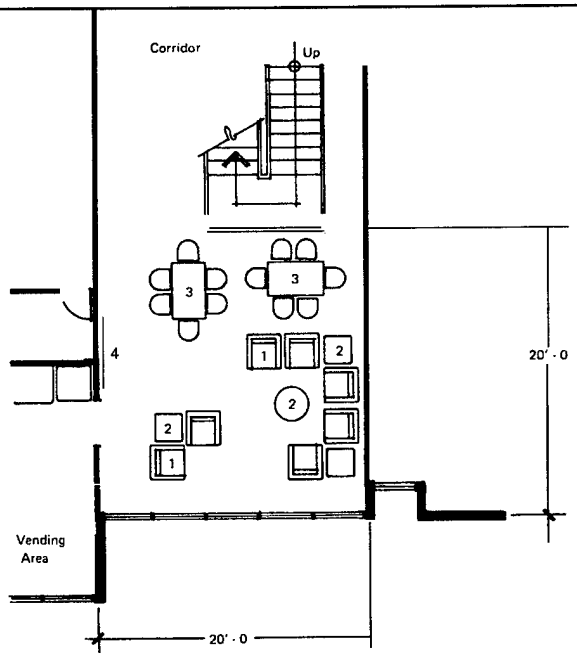


Figure 4-26 Student Lounge

4-5 SUPPORT SPACES (cont'd)

c. VENDING AREA	
Use	For vending and consumption of snacks, beverages, cigarettes, candy, etc. A separate space is also needed for storage.
Occupant load	12 persons (min)
Space allocation	3% of the combined NASF for academic and staff spaces; or 300 NASF (min)
Adjacency relationships	Locate adjacent to the student lounge and staff lounge.
Layout	See Figure 4-27

1. Stand-up Tables
2. Counter

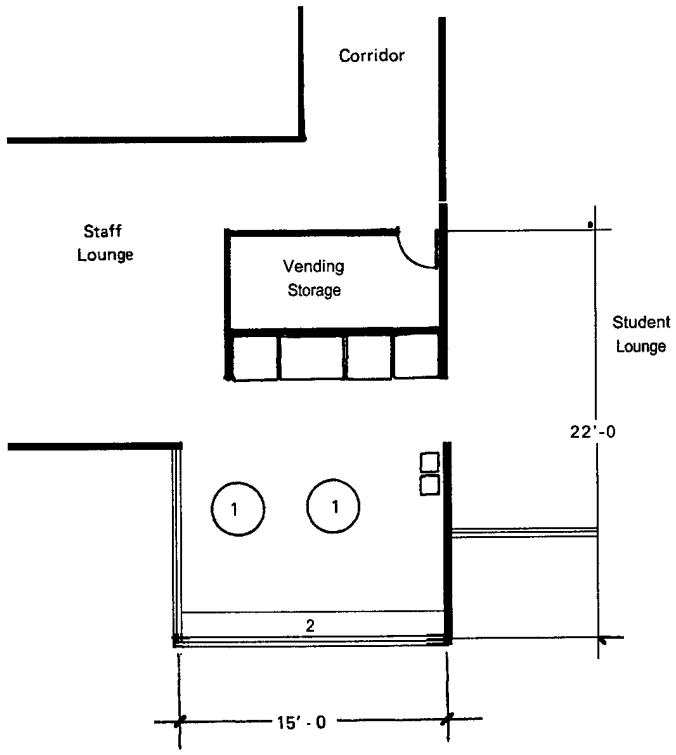


Figure 4-27 Vending Area

4-5 SUPPORT SPACES (cont'd)

d. TRAINING AIDS PREPARATION	
Use	For preparation of graphic aids and other material, and for duplication.
Occupant load	4 persons (min)
Space allocation	4% of the combined NASF for academic and staff spaces; or 300 NASF (min)
Adjacency relationships	Locate near staff offices and the receiving room.
Layout	See Figure 4-28

1. Layout Table and Stool
2. Storage Cabinet
3. Copy Equipment
4. Cabinet with sink
5. Shelving above
6. Tack/Chalk Surfaces

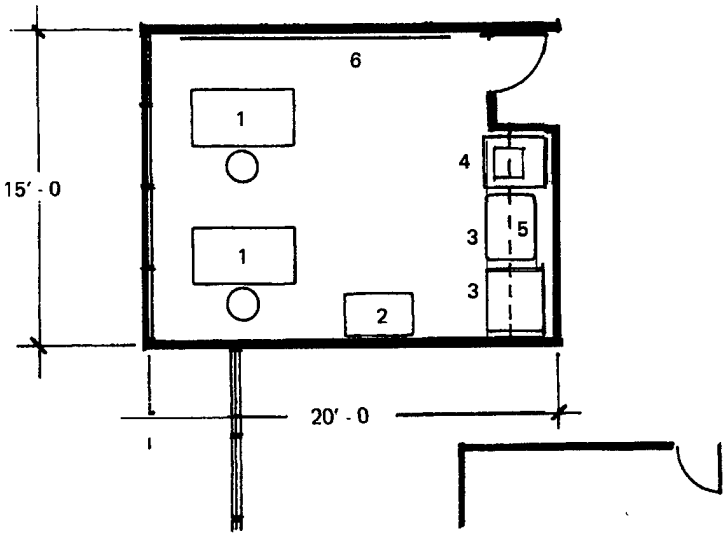


Figure 4-28 Training Aids Preparation

4-5 SUPPORT SPACES (cont'd)

e. TOILETS

Use

For sanitary purposes, shared between students and staff, with separate facilities for men and women. Separate space is required for lockers and showers in toilets serving vocational training space.

Occupant load

Varies

Male/Female Ratio

For toilets serving academic spaces, assume 25% utilization by women and 75% utilization by men unless local circumstances indicate otherwise. For toilets, showers and lockers serving vocational training spaces, assume 10% utilization by women and 90% utilization by men unless local circumstances indicate otherwise. Base assumptions on peak occupant loads in the respective areas that the facilities will support.

Fixture allocation

Water closets	1/40 men
	1/25 women
Urinals	1/40 men
Lavatories	1/25 men
	1/25 women
Showers	1/15 men
	1/15 women
Lockers	1/man
	1/woman

Space Allocation (unit estimates)

Water closet compartment	30 SF
WC compartment for handicapped	50 SF
Lavatory	15 SF
Urinal	15 SF
Shower compartment	35 SF
Locker tier (2 lockers/tier)	5 SF

Detailed provisions for handicapped persons shall conform to current criteria (EM 1110-1-103).

4-5 SUPPORT SPACES (cont'd)

Adjacency relationships	Locate toilets central to academic spaces and near to the main entrance and lounges. No occupant should have to travel more than 150 feet to reach a toilet facility. Toilets, including lockers and showers, serving vocational training spaces should be convenient to users, both inside and outside the building.
Layout	See Figure 4-29

1. Water Closet Compartment for Handicapped
2. Wheelchair Turn-a-round space
3. Lavatory for Handicapped
4. Urinal for Handicapped
5. Water Closet Compartment
6. Lavatory
7. Urinal

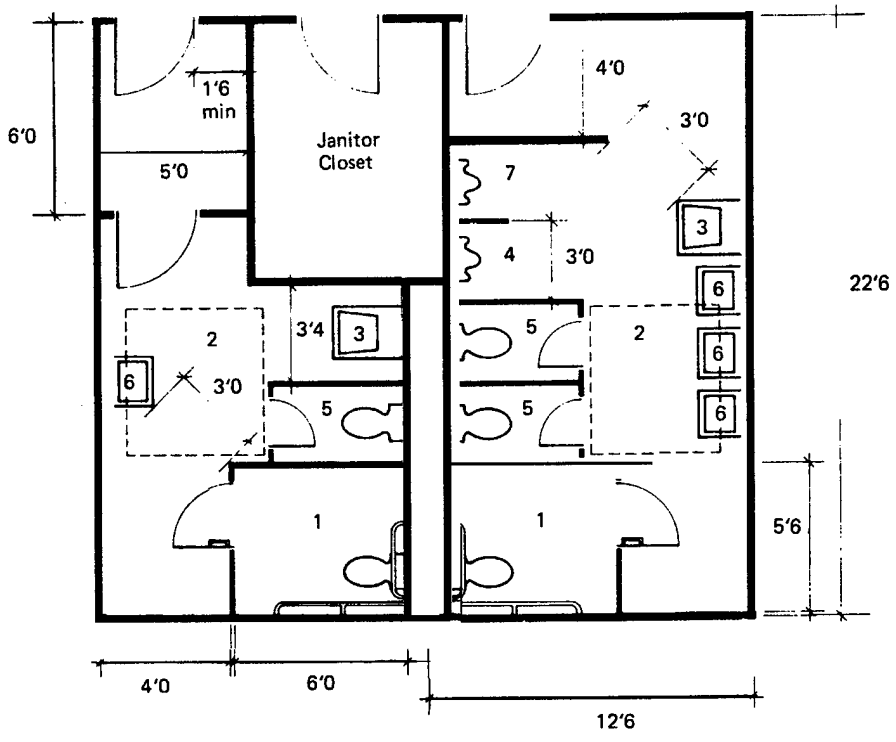


Figure 4-29 Toilets

4-5 SUPPORT SPACES (cont'd)

f. RECEIVING AND GENERAL STORAGE	
Use	For receiving, unpacking and temporary storage of educational materials and equipment.
Occupant load	5% of the combined NASF for academic and staff spaces; or 300 NASF (min).
Adjacency relationships	Locate close to an outside service entrance and staff spaces. General storage may be in a separate room but should be adjacent.
Layout	See Figure 4-30

1. Desk and Chair
2. Industrial Shelving
3. Work Table

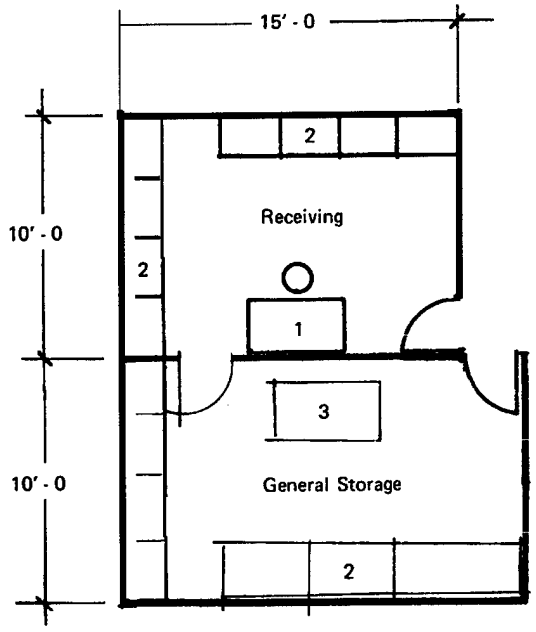


Figure 4-30 Receiving and General Storage

4-5 SUPPORT SPACES (cont'd)

g. JANITOR CLOSET	
Use	For housekeeping, preparations and storage of cleaning gear and supplies.
Occupant load	N/A
Space allocation	1% of the combined NASF for academic and staff spaces; or 90 NASF (min).
Adjacency relationships	Locate centrally to minimize walking distances and near toilets. Space may be segmented to other parts of the facility where need exists.
Layout	See Figure 4-31

1. Service Sink
2. Cabinet
3. Shelving
4. Mop Holder
5. Broom Holder
6. Brush Holder
7. Pail Hooks
8. Towel Bars
9. Tack Board

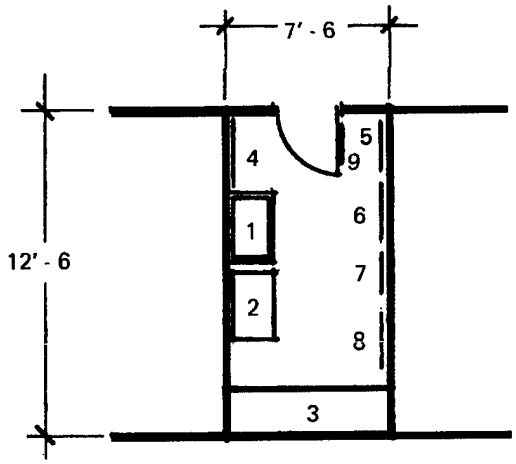


Figure 4-31 Janitor Closet

4-6 SUMMARY OF ENVIRONMENTAL CRITERIA

Table 4-1 covers environmental criteria for each individual space discussed in this chapter.

Table 4-1 Summary of Environmental Criteria for Individual Spaces

SPACE		Mechanical/Plumbing						Electrical						Lighting				Acoustical		
	Max Occupant Load	Thermostat	Air Changes/Hr	CW/HW	Floor Drain	Compressed Air	Exhaust	Intercom	Elec Outlets	PA Speaker	Telephone	Clock	TV/Elec Outlet	Daylight	Blackout Capability	Light Intensity FC	Dimming capability Task Light Supplement	Ambient dB	Estimated Peak dB	Sound Quality
Director's Office	1	X	6-8					X	X	(6)	X	X	X	X	X	70	0 0	40	75	AVE
Administrator	1	X	6-8					X	X	(6)	X	0	0	0	0	70	0	40	75	AVE
Clerk		X	6-8					X	X	(6)	X		0	0		70	0	40	75	AVE
Typist		X	6-8					X	X		X			0		70	0	45	75	AVE
Registrar	1	X	6-8					X	(9)	(6)	(9)	X	X	0		70	0	45	75	AVE
Information/Registration		0	6-8	(3)					X	X	(8)	0	X			60	X	50	80	ML
Counselor	1	X	6-8					X	X	(6)	X	0	0	0		70	0	40	75	AVE
Classroom	25	X	6-8						X	X	0	X	X	X		70	X 0	35	80	ML
Lecture Room	53	X	6-8						X	X	0	X	X	0	X	70	X 0	40	85	ML
Seminar Room	13	X	6-8						X	X	0	X	X	0	X	70	X	40	70	AVE
MOS Library	9	X	6-8					0	(7)	X	X	X		X		70	0	40	70	MD
Self-Paced Instr.	20	X	6-8						(7)	X	X	X	X	0	X	70	X X	35	70	MD
Language Lab	22	X	6-8						(7)	X	0	X	X	X	X	70	X	35	80	MD
Science Lab	25	X	(1)	X	(2)	0	X		X	X	0	X	X	X	X	70	X X	45	85	ML
Testing Room	50	X	6-8					X	X	X	X	X	X	0	X	70	X	35	75	AVE
Reh/Rec Studio	6	X	6-8						(5)	(6)		X	X		X	70	X X	30	75	D
Htg/Refrig/AC Shop	20	X	(1)	X	X	X	X		(5)	X	0	X	X	0		70	X	45	90	AVE
Constr. Electrician	20	X	(1)			X	X		(5)	X		X	X	0		70	X	50	90	ML
Comm/Indus. Electrician	20	X	(1)			X	X		(5)	X		X	X	0		70	X	50	90	AVE
Masonry	20	X	(1)	X	X		X		(5)	X		X	X	0		70	X	50	100	AVE
Carpentry	20	X	(1)	X	X	X			(5)	X		X	X	0		70	X	50	100	AVE
Plumbing	20	X	(1)	X	X	X			(5)	X		X	X	0		70	X	50	100	AVE
Diesel Mechanics	20	X	(1)	X	X	X			(5)	X		X	X	0		70	X	50	95	AVE
Auto Mechanics	20	X	(1)	X	X	X	X		(5)	X		X	X	0		70	X	55	95	AVE
Welding	20	X	(1)	X	X	X	X		(5)	X		X	X	0		70	X	50	85	AVE
Auto Body Repair	20	X	(1)	X	X	X	X		(5)	X		X	X	0		70	X	55	90	AVE
Small Eng. Repair	20	X	(1)	X	X	X	X		(5)	X		X	X	0		70	X X	45	95	AVE
Shop Conference Rms	—	X	6-8					X	X	X	0		0	0	X	70	X	40	70	ML
Staff Lounge		0	8-10					X	X	X	X	X	X	X		60	0 0	40	75	MD
Student Lounge		0	8-10	(3)					X	X	(8)	X	X	X		60	0 0	40	80	MD
Vending Area		0	(1)	(4)	X		X		(5)	0				0		70		45	80	ML
Training Aids Prep.		X	(1)	X			X	X	(5)	X	0	X	X	0	X	70	X X	40	80	AVE
Toilets			(1)	X	X		X		X	0				0		50	X	50	80	ML
Receiving/Gen. Stor.		0	6-8					X	X	X	X					50	X	55	70	ML
Janitor Closet			6-8	X	X				X							50		55	70	L

(1) 8-10 Air Changes/Hour minimum; exhaust requirements govern
(2) For emergency shower
(3) Drinking fountain desirable
(4) Some vending machines require cold water
(5) Also as required by equipment
(6) On/Off, volume control
(7) Also as required for AV carrels
(8) Pay telephone
(9) Also for computer terminal

X — Required
O — Optional

5-1 GENERAL.

This chapter describes space organization principles that may be employed in the development and review of designs. A principle is defined here as a rule exemplified in the organization and layout of a building design, after the space requirements have been established as discussed in Chapter 2, paragraph 2-5. Principles are described in this chapter in relation to the following. general design sequence.

a. ESTABLISH AFFECTS OF THE SITE. Principles concerning site topography, climate, size and shape, orientation, etc., will determine the general configuration and location of the building on the site.

b. ESTABLISH BASIC SPATIAL ORGANIZATION. The site constraints together with the overall mission and desired image of the ACES Center will help establish the scheme of spatial organization best suited to an individual project.

c. DEVELOP FUNCTIONAL LAYOUT. Principles concerning functional adjacency, circulation, control, acoustics, etc., will determine the location of spaces within the basic configuration.

d. DEVELOP STRUCTURAL AND ENVIRONMENTAL SUPPORT MODULES. Principles concerning mechanical zoning, ceiling height, structural loading, modularity, and maintenance will determine adjustments to the building layout needed to make the facility habitable and constructible.

e. DEVELOP CONCEPT FLOOR PLAN.

5-2 PRINCIPLES RELATED TO SITE CONSTRAINTS AND OPPORTUNITIES

a. ORGANIZE SPACES IN RELATION TO THE SIZE, SHAPE AND ORIENTATION OF THE SITE. Based on the maximum coverage of the site desired, the building may be single-story or multi-story. Space organization must also consider the orientation of the site which will tend to determine the locations that will provide views and natural lighting or that will require protection against sun and glare.

b. ORGANIZE SPACES TO FIT INTO THE NATURAL TOPOGRAPHY. Existing ground forms, trees and other site features should be preserved insofar as is reasonably possible. At the same time the space organization must function efficiently both indoor and outdoor. For example, a sloping site may suggest a split-level facility to preserve natural features, while access for the physically handicapped from parking areas into the building may require grading to reduce slopes in certain areas. Spaces should be organized to take advantage of existing views.

c. ORGANIZE SPACES SO THAT THEY MAY BENEFIT FROM NATURAL WARMING AND COOLING EFFECTS. Where possible, building forms, courtyards, earth mounds, vegetation and trees should be provided to capture or direct air movement as well as to control the effects of the sun.

5-2 PRINCIPLES RELATED TO SITE CONSTRAINTS AND OPPORTUNITIES (cont'd)

d. ORGANIZE SPACES IN RELATION TO VEHICULAR/PEDESTRIAN CIRCULATION. This must be accomplished with respect to access (to both site and building) by students, visitors and staff (including the handicapped), maintenance and service personnel.

(1) The main entrance should be visible from both the parking lot and the street.

(2) Service entrances should not be visible from the parking lot and the street, but should be identified with signs.

e. ORGANIZE SPACES TO ALLOW FUTURE EXPANSION OF FACILITIES. Existing or planned facilites which would limit orderly growth must be taken into consideration. If the building expands, site amenities such as parking will also require expansion.

5-3 PRINCIPLES RELATED TO BASIC SPATIAL ORGANIZATION

a. ORGANIZE SPACES INTO BASIC ORGANIZATIONAL SCHEMES. Spaces should be grouped to afford compatibility of activities, circulation and service requirements. The following three schemes are most applicable to ACES facilities:

(1) Parallel Organization. This scheme is characterized by parallel circulation spines along which groups of spaces with similar functions are arranged. The academic and staff spaces are arranged along one spine, and the vocational-training spaces are grouped separately along another spine, as shown in Figure 5-1. The parallel scheme gives distance between academic and vocational-training activities which facilities noise control, but may inhibit visual control. This type of scheme provides excellent opportunities for expansion, but may be difficult to adapt to unusual site conditions.

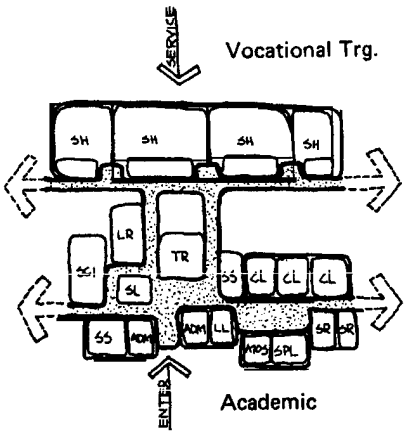


Figure 5-1 Parallel Organization Scheme

5-3 PRINCIPLES RELATED TO BASIC SPATIAL ORGANIZATION (cont'd)

(2) Axial Organization. This scheme is developed by dividing the circulation into two axial paths separating the academic and vocational-training spaces along two different axes as shown in Figure 5-2. Spaces can be arranged along the axis on one or both sides. The axial scheme facilitates both noise and visual control. It also provides excellent opportunity for expansion of facilities and adapts well to varying site conditions.

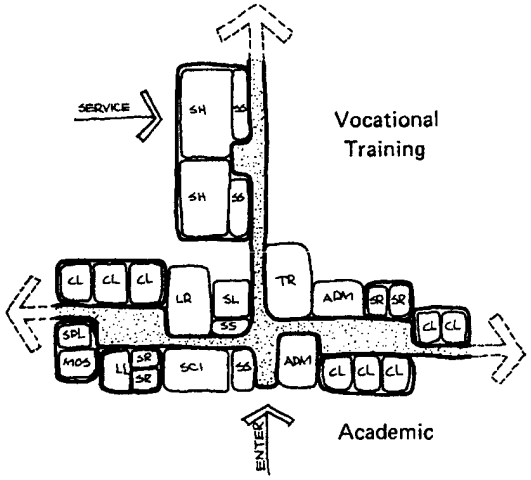


Figure 5-2 Axial Organization Scheme

(3) Dispersed Organization. This scheme is characterized by circulation linkages that both connect and separate activities. Academic and vocational-training spaces are arranged along individual spines, separated by a connector spine along which staff and support spaces are arranged as shown in Figure 5-3. The dispersed scheme also facilitates good noise control but may inhibit visual control. This scheme is more suitable for severe climate conditions but may have limited adaptability to difficult site conditions.

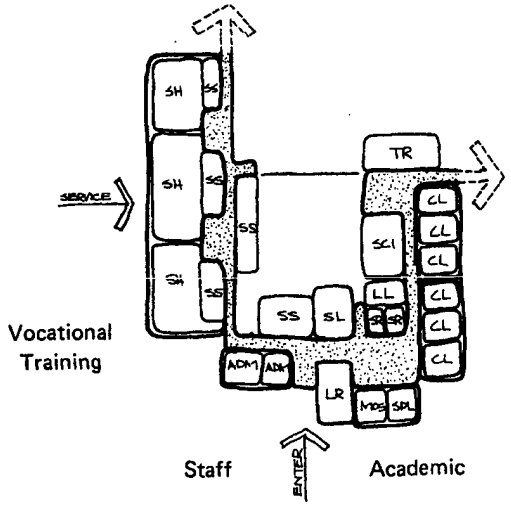


Figure 5-3 Dispersed Organization Scheme

5-3 PRINCIPLES RELATED TO BASIC SPATIAL ORGANIZATION (cont'd)

b. ORGANIZE SPACES IN CONJUNCTION WITH PLANNED SEQUENCES OF VIEWING POSITIONS. Each viewing position should be used to create a perceptual experience for participants as they move through the spatial organization scheme. Such experiences can be created by: arranging spaces to emphasize volumetric differences in heights, widths and lengths; through the use of focal points established by light, form and color (including natural elements inside and out); and through the use of decorative elements (color, texture, light and form) to establish visual rhythm and movement. Sequences of viewing positions should always be coordinated with circulation flows even though they may involve separate paths.

5-4 PRINCIPLES RELATED TO FUNCTIONAL LAYOUT.

a. ORGANIZE SPACES TO ESTABLISH WORKABLE ADJACENCY RELATIONSHIPS. Students, visitors and staff must interact with one another, and some activities must be closely associated. Generally, the greater the interaction of persons and activities, or flow of materials between one space and another, the closer the spaces should be to each other.

b. ORGANIZE SPACES TO ESTABLISH A CONVENIENT CIRCULATION FLOW. Visitors and students must be able to easily enter and exit the building and find the activities and staff provided. Staff must also be able to readily perform the tasks required, moving the material and equipment necessary to conduct instructional and other functions. Usually, spaces which generate heavy traffic should be located near to entrances, and those frequented by persons unfamiliar with the ACES Center should be near the main entrance.

c. ORGANIZE SPACES SO THAT ALL PERSONS CAN BE EFFECTIVELY EVACUATED DURING AN EMERGENCY. Space should be located, with respect to type and load of occupancy, to minimize distance of travel to safe outside exits, o-r to protective construction zones.

d. ORGANIZE SPACES FOR FLEXIBILITY OF SPACE USE. Spaces should be organized so that they may be combined, separated or slightly modified to enhance the versatility of the building and to accommodate possible changes in ACES program functions. Space organization should allow for changes in degree of privacy, from being open for visual control to being closed for privacy.

e. ORGANIZE SPACES TO SIMPLIFY VISUAL CONTROL. Spaces requiring surveillance and control should be organized so that there is capability to supervise from a central viewing position or positions. Capability to supervise entrance and exit traffic, use of toilets and equipment is an example.

f. ORGANIZE SPACES IN RELATION TO SOUND LEVEL COMPATIBILITY. Cluster spaces which produce high noise levels so they can be more economically isolated or located remote from quiet spaces. Separate noisy from quiet spaces with circulation, storage and toilet spaces where possible.

5-5 PRINCIPLES RELATED TO STRUCTURE AND ENVIRONMENTAL SUPPORT.

a. ORGANIZE SPACES TO MAXIMIZE ECONOMY OF STRUCTURE. Establish a standard module (where applicable) which is efficient and economical for both the layout of structure and the layout of ceiling and wall systems, lighting and air handling equipment. The structure must handle critical floor loads and allow for possible multi-use. Overall, the building should be made as compact as possible, to minimize both structure and HVAC support in terms of heat loss and/or gain.

b. ORGANIZE SPACE TO MINIMIZE REQUIREMENTS FOR RESISTIVE CONSTRUCTION AND/OR EXTINGUISHMENT SYSTEMS. Group spaces requiring this type of protection.

c. ORGANIZE SPACES TO PROVIDE PROTECTIVE CONSTRUCTION ZONES. Where fallout or storm protection is required, spaces which employ resistive construction for other purposes (e.g., fire protection) and those that may have built-in characteristics for providing such protections should be organized where possible into dual-use protective zones.

d. ORGANIZE SPACE TO MAXIMIZE ECONOMY OF ENVIRONMENTAL SUPPORT SYSTEMS. Spaces should be organized into comfort zones where different lighting and/or HVAC may be required to support the activity in the space or group of spaces. (See chapter 4, Table 4-1 for a summary of environmental criteria.) Spaces requiring plumbing services should be organized to minimize pipe runs, for both supply and waste. Space for mechanical/electrical equipment requiring the attention of facilities engineer personnel and communications officer such as for operation, maintenance and repair purposes, should be located to provide both efficient service to respective groups of spaces, and access from the outside.

6-1 GENERAL

This chapter demonstrates the application of criteria in developing concept alternatives for different ACES Center projects to serve the given military strength of 6,000, 10,500 and 21,000 persons. One example is given for each size military strength in Schemes A, B and C. Scheme A, discussed in para 6-2, most fully illustrates the planning and programing process. Schemes A-1, B-1 and C-1 follow as alternative designs to illustrate the affect of different site conditions on space organization. The procedure, as well as the information, is in abbreviated form to illustrate the most important considerations. An in-depth analysis with detailed information from each particular installation will be required in planning and designing an actual project.

6-2 EXAMPLE DESIGN-SCHEME A FOR 6,000 MILITARY STRENGTH

a. SITUATION. The project is located on an installation in the Midwestern United States. The existing ACES activity is housed in two separate structures which were converted from barracks and are both inefficient and unable to meet current needs. A relatively small rectangular site is identified on the master plan for a new ACES Center, and the installation commander has requested that a new facility be provided. The project site is within walking distance of the Exchange and main Library. It is gently sloping to the southwest and is defined by a secondary road on the south. The site has no significant features or views.

The existing program has a fairly constant semester enrollment of 700 people that utilize facilities at different times during the week. The activity operates five days per week from 7:30 a.m. to 4:00 p.m. with some classes occasionally meeting in the evening from 7:30 to 9:00 p.m. Although classes are not held on weekends, some space is used for recreational activities such as movies and lectures in order to supplement a relatively small and already over-burdened Recreation Center.

b. PLANNING DATA

(1) Authorized Space Allowance. A 6,000 person (military strength) installation is allowed (Table 2-1) up to 16,920 GSF, excluding mechanical space, for an ACES Center.

(2) Staffing. Authorized staffing is shown in Table 6-1.

6-2 EXAMPLE DESIGN-SCHEME A FOR 6,000 MILITARY STRENGTH (cont'd)

Table 6-1 Example Staffing for Military Strength of 6,000

Type	No. of Authorized Staff
Director	
Administrator	
Clerk	
Typist	2
Registrar	1
Counselors	5
Total	11

(3) Anticipated Courses and Enrollment. Based on a ten-year projection of student needs at the installation, a range of programs, courses and services is anticipated and include the following: Basic Skills Education Programs (BESEP), Skill Development, Counseling, ACES testing, MOS related instruction, foreign language instruction, group study classes, baccalaureate and advanced degree programs. The typical semester courses and enrollment anticipated are shown in Table 6-2.

(4) Assignment of courses to Instructional Space Types. Referring to the individual space types in Chapter 4 (Academic; para 4-3); each course anticipated to be taught at the ACES Center is assigned to a specific space type (Classroom, Lecture Room, Science Lab, etc.). The number of hours per week that the space type is required ("C" Value) is then determined by using the parameters set forth in Chapter 2 (Table 2-2). In this example, the courses assigned to a "Classroom" type space are shown in Table 6-3, along with the parameters set forth in Chapter 2 to determine the "C" Value. Detail assignments to other space types and "C" value determinations are not shown.

6-2 EXAMPLE DESIGN-SCHEME A FOR 6,000 MILITARY STRENGTH (cont'd)

Table 6-2 Typical Semester Courses & Enrollment Based on 10-Year Projection Example for Military Strength of 6,000

Course Designation	Enrollment
Academic	
1. English 1	88
2. English 2	67
3. English Comp.	60
4. English Literature	12
5. World Literature	10
6. Arithmetic	38
7. Business Math	48
8. Principles of Accounting	48
9. Algebra 1	47
10. Geometry	31
11. Trigonometry	35
12. Calculus	20
13. Statistics	15
14. Principles of Real Estate	9
15. History 1	46
16. History 2	38
17. Ancient History	11
18. Philosophy	8
19. Middle Eastern Culture	9
20. History of Art	11
21. Biology	24
22. Chemistry	18
23. Physics	30
24. Spanish	21
25. French	18
26. German	14
27. Audio-Visual Lesson Materials	48
Vocational Training	
none	
TOTAL ANTICIPATED ENROLLMENT PER SEMESTER	724

6-2 EXAMPLE DESIGN-SCHEME A FOR 6,000 MILITARY STRENGTH (cont'd)

Table 6-3 Example Projected Space Type Utilization

SPACE TYPE: CLASSROOM

Course Designation	Typical Semester Enrollment	Max Class Size	No. of Classes	Hrs/wk Ea. Class Meets	Hrs/wk Required
English 1	88 students	24	4	4	16
English 2	67	24	3	4	12
Algebra 1	47	24	2	5	10
Geometry 1	31	24	2	5	10
Trig 1	35	24	2	5	10
Arithmetic	38	24	2	5	10
Calculus	20	24	1	5	5
History 1	46	24	2	5	10
History 2	38	24	2	5	10
English Comp	60	24	3	4	12
TOTAL HRS/WK SPACE TYPE IS REQUIRED					C = 105

(5) Determination of Number of Each Space Type. The number of each type of space required is determined by using the formula N = c/uh as set forth in Chapter 2 (para 2-5b(5)). Utilizing the "C" value established in Table 6-3, a 40 hour/week operation ("h" value), and a 0.8 utilization rate ("u" value), the number of classrooms required is determined as follows:

$$N = \frac{105}{0.8} \times 40; \qquad N = 3.3$$

Rounded up to the nearest whole integer the number of classrooms required is 4. The same process is used to determine the number of other instructional spaces required for the total project. The types and number of academic spaces required for this example project are shown in Table 6-4. The occupant load is also identified in order to help determine the requirement for toilet fixtures later on.

6-2 EXAMPLE DESIGN-SCHEME A FOR 6,000 MILITARY STRENGTH (cont'd)

Table 6-4 Number of Academic Spaces Needed-Example

Type of Academic Space/Occupant Load Each	No. Required	Occupant Load
Classroom/25	4 req'd *; bal. = 2	50
Lecture Room/53	1	53
Seminar Room/13	3	39
MOS Library/9	1	9
Self-Paced Instruction/20	1	20
Language Lab/22	1	22
Science Lab/25	1	25
Testing Room/37 (as classrooms/50)	1	50
Rehearsal and Recording Studio/6	1	6
* Testing Room will serve as 2 classrooms		
	Academic Occupant Load	274

(6) Survey of Existing Suitable Facilities. In this example, no space requirements can be subtracted since there are no existing facilities within eight-minutes walking distance that are suitable.

(7) Academic Space Requirements. By multiplying the number of spaces required for each space type times the NASF space allocated in Chapter 4, para 4-3, the total academic space required is determined as shown in Table 6-5.

Table 6-5 Academic Space Requirements-Example

Type of Space	No. of Spaces Required	x	NASF/Space Allocated	=	Total NASF
Classroom	2		750		1500
Lecture Room	1		1500		1500
Seminar Room	3		375		1125
MOS Library	1		750		750
Self-Paced Instruction	1		750		750
Language Lab	1		750		750
Science Lab	1		1500		1500
Testing Room	1		1905		1905
Reh/Rec Studio	1		375		375
Total Academic Space Required					10,155 NASF

6-2 EXAMPLE DESIGN-SCHEME A FOR 6,000 MILITARY STRENGTH (cont'd)

(8) Staff Space Requirements. Based upon the staffing authorized (Table 6-1) and the space allowances stated in Chapter 4, para 4-2, the total staff space required is derived by multiplying the number of spaces required times the NASF space allocated as shown in Table 6-6.

Table 6-6 Staff Space Requirements-Example

Type of Space	No. of Spaces Required	x	NASF/Space Allocated	=	Total NASF
Director	1		200		200
Administrator	1		150		150
Clerk	1		100		100
Typist	2		75		150
Registrar	1		100		100
Information			150		150
Storage			75		75
Counselors	5		100		500
Reference			150		150
Total Staff Space Required					1575 NASF

(9) Support Space Requirements. Determination of support space requirements is based upon the percentages of combined NASF (for academic and staff spaces) and minimum allocations given in Chapter 4, para 4-5. Requirements for toilet facilities are based upon peak occupant load male/female ratio, fixture allocation, and unit space allowances (para 4-5.e.). In this example, the combined NASF is 10,155 + 1575; or 11,730. The peak occupant load is assumed to be 274 (academic) + 11 (staff); or 285. Computation of total support space required for this project is shown in Table 6-7.

Table 6-7 Support Space Requirements-Example

Type of Space	NASF/Space Allocated	Total NASF
Staff Lounge	1.5% x 11,730 NASF* (min 150 NASF)	175
Student Lounge	5.5% x 11,730 NASF (min 400 NASF)	645
Vending Area	3% x 11,730 NASF (min 300 NASF)	350
Training Aids Prep.	4% x 11,730 NASF (min 300 NASF)	470
Toilets (for 285**)	See para 4-5.e., Chapter 4	
Men (213)	6 WC, 5 UR, 9LAV	410
Women (72)	3 WC, 3 LAV	155
Receiving/Gen. Stor.	5% x 11,730 NASF (min 300 NASF)	585
Janitor Closet	1% x 11,730 NASF (rein 90 NASF)	120
TOTAL SUPPORT SPACE REQUIRED		2,910 NASF

*Combined NASF for academic and staff spaces

**Peak occupant load.

6-2 EXAMPLE DESIGN-SCHEME A FOR 6,000 MILITARY STRENGTH (cont'd)

(10) Gross Space Requirement. Gross space (GSF) is determined by allowing 15% of the total NASF for academic, staff and support spaces for circulation, exterior walls, etc. Since space for the building's mechanical equipment is not figured as part of the gross space, such space must be determined separately and added to the gross total. Table 6-8 summarizes the space requirements for this example.

Table 6-8 Tabulated Space Requirements and Occupant Capacity Example for Military Strength of 6,000

	Load	SF
Staff Spaces		
Director	1	200
Administrator	1	150
Clerk	1	100
Typists (2)	2	150
Registrar	1	100
Information and Storage	—	225
Counselors (5)	5	500
Reference	—	150
Total Staff Capacity	11	1,575
Academic Spaces		
Classrooms (2)	50	1,500
Lecture Room	53	1,500
Seminar Rooms (3)	39	1,125
MOS Library	9	750
Self-Paced Instruction	20	750
Language Lab	22	750
Science Lab	25	1,500
Testing Room (2 classrooms)	50	1,905
Rehearsal/Recording Studio	6	375
Total Student Capacity	274	10,155
Support Spaces		
Staff Lounge		175
Student Lounge		645
Vending Area		350
Training Aids Preparation		470
Toilets—men		410
—women		155
Receiving/Gen. Storage		585
Janitor Closet		120
		2,910
Net Total		14,640 NASF
Net to Gross Space at 15%		2,195
Gross Total (maximum allowable target–16,920 GSF)		16,835 GSF
Mechanical Space		150

6-2 EXAMPLE DESIGN-SCHEME A FOR 6,000 MILITARY STRENGTH (cont'd)

d. DESIGN SOLUTION

(1) Basic Spatial Organization. Since this example project does not include vocational training spaces and must be designed to fit on a long, narrow site, a simple linear scheme, modified from the parallel and axial schemes is used. Primary access is provided at one end which adjoins the parking area as shown in Figure 6-1.

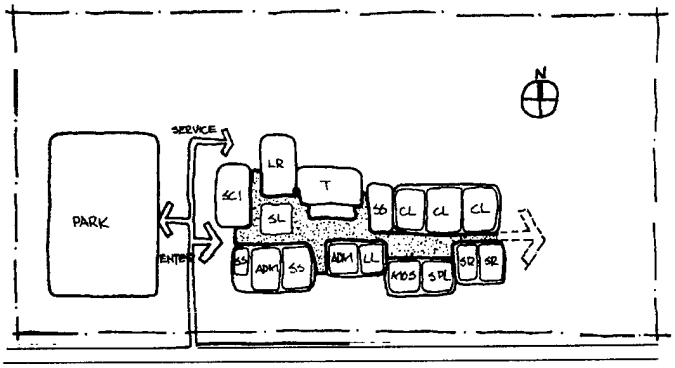


Figure 6-1 Basic Spatial Organization-Scheme A

(2) Example Plan. This example design is developed around two courtyards along the primary circulation spine as shown in Figure 6-2. The courtyards are used to create volumetric interest in conjunction with a set of viewing positions planned along the scheme. They are also used to provide natural light and greenery to the interior of the building, creating focal points around which various functional spaces are clustered. The information/registrar area is located adjacent to the main entrance to serve as a control point for the building. The student lounge is located on the circulation spine adjacent to the vending area and the lecture room for multi-use purposes. Counselor offices are centrally located for easy access from the main entrance to serve the needs of both students enrolled in courses and military personnel who come for counseling only. Toilets are placed at the approximate center of the circulation spine in order to best serve the entire building. Employing the basic 5-foot module system discussed in Chapter 3., the 25 ft x 30 ft (750 SF) module is utilized for all academic and staff spaces. The modules are offset at various points to create the interior courtyard spaces.

6-2 EXAMPLE DESIGN-SCHEME A FOR 6,000 MILITARY STRENGTH (cont'd)

1. Entrance
2. Director
3. Administrator
4. Clerk
5. Typists
6. Information & Registration
7. Storage
8. Training Aids Preparation
9. Counselors
10. Conference Room
11. Instructor's Rehearsal/Recording Studio
12. Classroom
13. Seminar Room
14. Lecture Room
15. MOS Library
16. Self-Paced Instruction
17. Science Lab
18. Language Lab
19. Testing Room and Related Facihtles
20. Staff Lounge
21. Student Lounge
22. Vendng Area
23. Vending Storage
24. Men's Toilet
25. Women's Toilet
26. Janitor's Closet
27. Receiving Room
28. General Storage
29. Secondary Entrance
31. Landscape Court
32. Student and Staff Parking
33. Handicapped Parking
35. Service Area

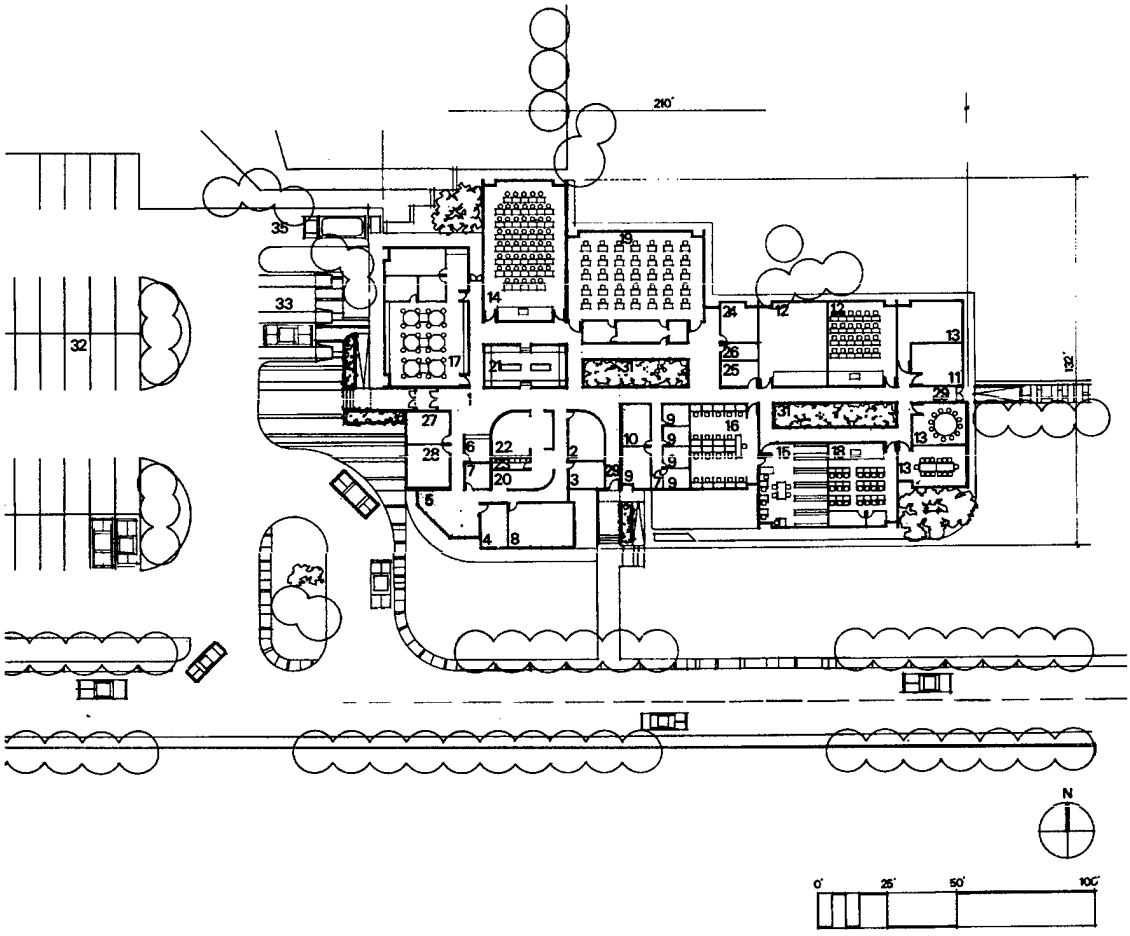


Figure 6-2 Example Plan-Scheme A Education Center for 6000 Military Strength

6-3 EXAMPLE DESIGN-SCHEME A-1 FOR 6,000 MILITARY STRENGTH

a. SITUATION. The requirements of this project are similar to those for Scheme A. However, in this case, the installation is located in an area that is subject to more severe weather conditions, particularly in the winter. The site, which is immediately adjacent to the Main Library, is very small and narrow, with limited space for development of parking facilities. However, the parking spaces available on the library site can be shared with the ACES Center given proper access provided by good site planning.

b. PLANNING. The authorized space allowance and staffing, and the enrollment and usage of the ACES Center are the same as determined in Scheme A. The space requirements are the same as those indicated in Table 6-8.

c. DESIGN SOLUTION.

(1) Basic Spatial Organization. This ACES Center, basically organized as a simple linear/modified axial scheme, is dictated by the configuration of the site. Due to the limited site area and the space requirements of the program, a two-story scheme is necessary. The two-story configuration also helps conserve energy by exposing less building surface to the elements. An axis perpendicular to the main linear axis is desired to connect the new ACES facility to the existing library as shown in Figure 6-3.

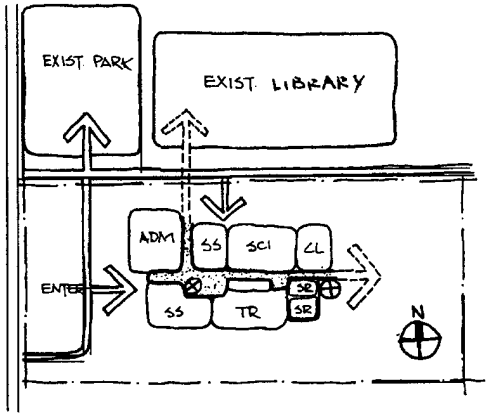
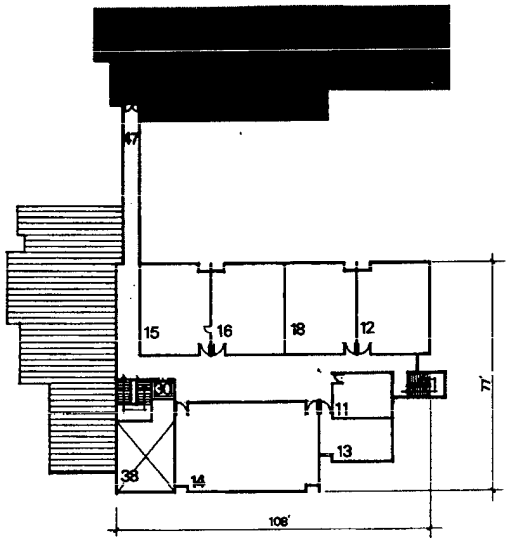


Figure 6-3 Basic Spatial Organization-Scheme A-1

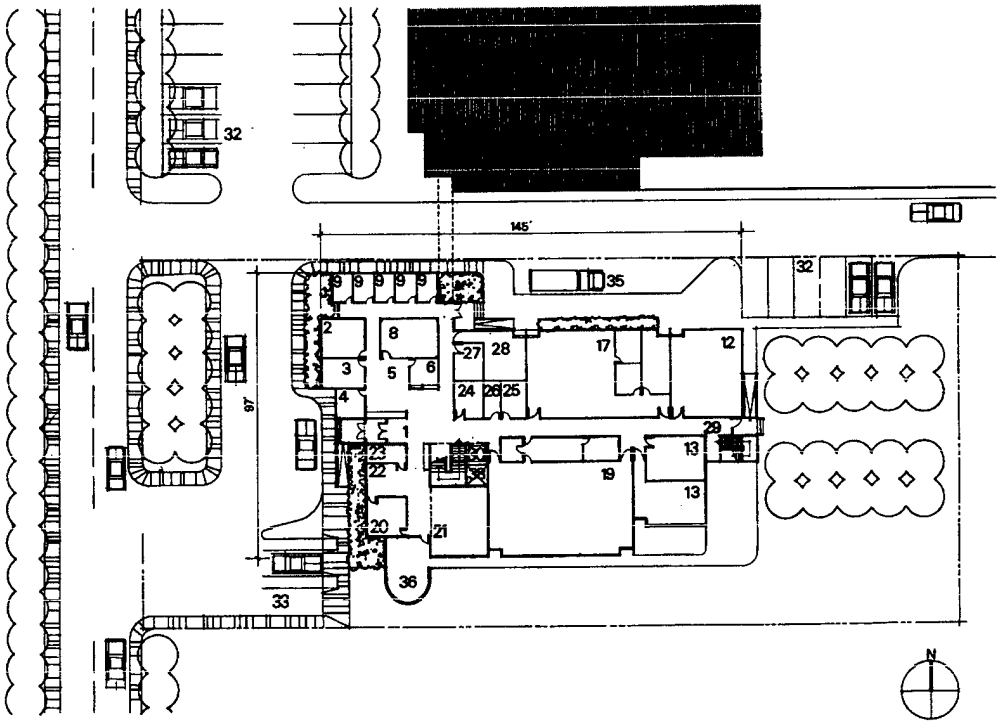
(2) Example Plan. Staff and support spaces are located near the main and service entrances on the ground level as shown in Figure 6-4. Academic spaces are located on two floors with classroom, lecture room, MOS library and self-paced learning room located on the second floor, linked to the existing library. The 750 SF module again forms the basic layout system in this example solution.

6-3 EXAMPLE DESIGN-SCHEME A-1 FOR 6,000 MILITARY STRENGTH (cont'd)

1. Entrance
2. Director
3. Administrator
4. Clerk
5. Typists
6. Information & Registration
8. Training Aids Preparation
9. Counselors
11. Rehearsal/Recording Studio
12. Classroom
13. Seminar Room
14. Lecture Room
15. MOS Library
16. Self-Paced Instruction
17. Science Lab
18. Language Lab
19. Testing Room and Related Facilities
20. Staff Lounge
21. Student Lounge
22. Vending Area
23. Vending Storage
24. Men's Toilet
25. Women's Toilet
26. Janitor's Closet
27. Receiving Room
28. General Storage
29. Secondary Entrance
30. Elevator
32. Student and Staff Parking
33. Handicapped Parking
35. Service Area
36. Terrace
38. Open Space over Lounge
47. Connector to Existing Library



SECOND FLOOR PLAN



FIRST FLOOR PLAN

Figure 6-4 Example Plan-Scheme A-1—Education Center For 6,000 Military Strength

6-4 EXAMPLE DESIGN-SCHEME B FOR 10,500 MILITARY STRENGTH

a. SITUATION. This project is located on an installation in the southwestern United States. Currently, the ACES activity is housed in several temporary buildings which are scheduled for demolition in order to build new bachelor housing. A new ACES Center site is identified on the master plan that is relatively large and irregular in configuration with a secondary road on the southern property line.

The ACES Program is projected to have a fairly constant scheduled enrollment of approximately 1050 people who will utilize facilities at various times during the week. Eventual growth of the Center is expected to take place primarily in the vocational training program. The Center will operate a full program five days per week and will offer a partial program on Saturday for a total operation of 48 hours per week.

b. PLANNING DATA

(1) Authorized Space Allowance. A 10,500 person (miltary strength) installation is allowed (Table 2-1) up to 27,440 GSF, excluding mechanical space, for an ACES Center.

(2) Staffing. Authorized staffing is shown in Table 6-9.

Table 6-9 Example Staffing For Military Strength Of 10,500

Type	No of Authorized Staff
Director	1
Administrator	2
Clerk	2
Typist	2
Registrar	1
Counselor	9
Total	17

(3) Gross Space Requirement. Table 6-10 summarizes the space required for this example. Although the computations are not shown in detail, the requirements are based on the staffing authorized in Table 6-9 and a projected enrollment and course requirement.

6-4 EXAMPLE DESIGN-SCHEME B FOR 10,500 MILITARY STRENGTH (cont'd)

Table 6-10 Tabulated Space Requirements And Occupant Capacity Example For Military Strength Of 10,500

	Load	SF
Staff Spaces		
Director	1	200
Administrators (2)	2	300
Clerks (2)	2	200
Typists (2)	2	150
Registrar	1	100
Information and Storage	—	250
Counselors (9)	9	900
Reference	—	150
Total Staff Capacity	17	2,250
Academic Spaces		
Classrooms (2)	50	1,500
Lecture Room	53	1,500
Seminar Rooms (3)	39	1,125
Self-Paced Instruction	20	750
MOS Library	9	750
Language Lab	22	750
Science Lab	25	1,500
Testing Room (2 classrooms)	50	1,905
Rehearsal/Recording Studio	6	375
	274	10,155
Vocational Training Spaces		
Auto Body Repair Shop	20	5,075
Heating/Refrig/AC Shop	20	2,200
	40	7,275
Total Student Capacity	314	
Support Spaces		
Staff Lounge		185
Student Lounge		685
Vending Area		375
Training Aids Preparation		500
Toilets-218 men (410 SF), 73 women (155 SF)		565
Toilets-Vo. Training Area, 36 men (255), 4 women (1 10)		365
Receiving/Gen. Storage		620
Janitor Closet		125
		3,420
Net. Total		23,100 NASF
Net to Gross Space at 15%		3,465
Gross Total (maximum allowable target 27,440 GSF)		26,565 GSF
Mechanical Space		300

6-4 EXAMPLE DESIGN-SCHEME B FOR 10,500 MILITARY STRENGTH (cont'd)

c. DESIGN SOLUTION

(1) Basic Spatial Organization. This solution is developed around an outwardly oriented, axial organization scheme as shown in Figure 6-5. This takes advantage of the irregular site configuration and natural ventilation possibilities.

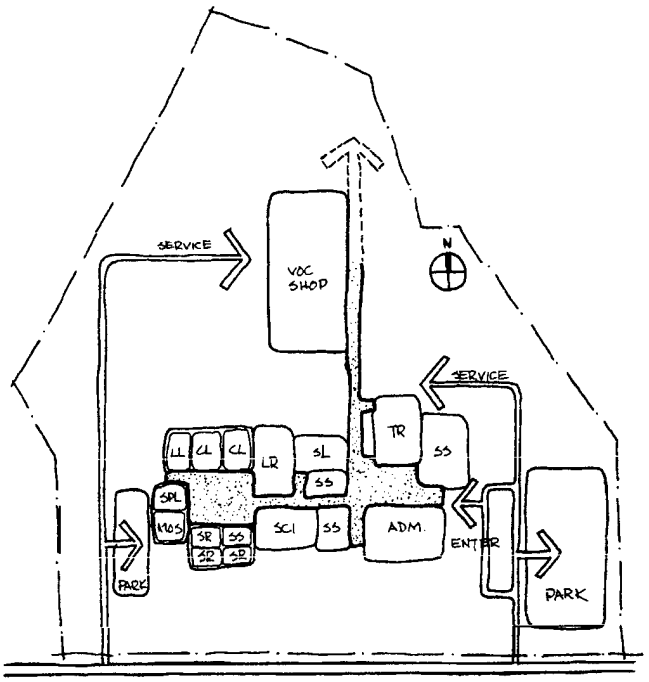


Figure 6-5 Basic Spatial Organization-Scheme B

(2) Example Plan. The plan radiates from a central student lounge space and courtyard near the main entrance. These spaces, and an additional courtyard in the academic area, provide volumetric rhythm to the space organization scheme and create focal points of natural light and greenery in conjunction with the viewing position/circulation paths. Staff, counseling, and support functions are located directly adjacent to the entrance area. The central student lounge space is adjacent to the lecture room and an outside demonstration area. Another, but smaller student lounge space, is adjacent to the vending area and outside terrace. Toilets are located near the center of the axis. Academic classrooms and laboratories are organized around the other interior courtyard. Vocational training shops are together in a separate structure connected to the academic/staff element by a covered pedestrian walkway. The 25 x 30 ft (750 SF) module forms the basic layout of the academic building. The larger 30 x 50 module has been used for the vocational training shops.

6-4 EXAMPLE DESIGN-SCHEME B FOR 10,500 MILITARY STRENGTH (cont'd)

1. Entrance
2. Director
3. Administrator
4. Clerk
5. Typists
6. Information and Registration
7. Storage
8. Training Aids Preparation
9. Counselors
11. Rehearsal/Recording Studio
12. Classroom
13. Seminar Room
14. Lecture Room
15. MOS Library
16. Self-Paced Instruction
17. Science Lab
18. Language Lab
19. Testing Room and Related Facilities
20. Staff Lounge
21. Student Lounge
22. Vending Area
23. Vending Storage
24. Men's Toilet
25. Women's Toilet
26. Janitor's Closet
27. Receiving Room
28. General Storage
29. Secondary Entrance
31. Landscaped Court
32. Student and Staff Parking
33. Handicapped Parking
35. Service Area
36. Terrace
37. Outdoor Demonstration Area
39. Shop Toilets
40. HVAC Shop
44. Auto Body Repair Shop
45. Auto Storage
46. Fence

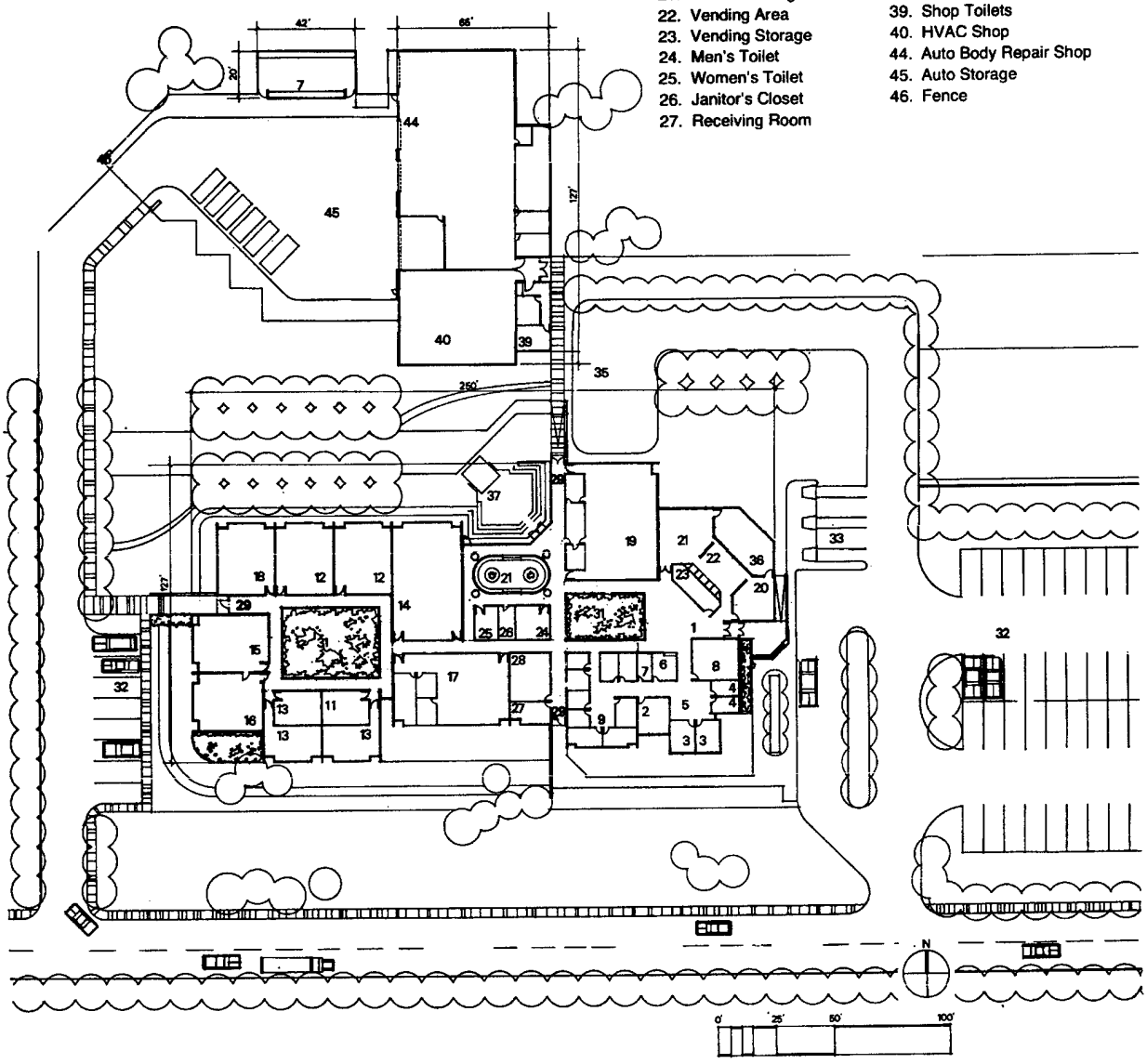


Figure 6-6 Example Plan Scheme-B– Education center for 10,500 Military Strength

6-5 EXAMPLE DESIGN-SCHEME B-1 FOR 10,500 MILITARY STRENGTH

a. SITUATION. The mission, size and location of this project are the same as described in Scheme B, however, the site which has been designated on the master plan has a rock outcropping with a steep rise at the northeast corner which makes almost one-third of the site unusable. An existing library is located directly to the west.

b. PLANNING. The authorized space allowance and staffing, and the projected enrollment and usage of the ACES Center are the same as determined in Scheme B. The space requirements are the same as those indicated in Table 6-10.

c. DESIGN SOLUTION.

(1) Basic Spatial Organization. This solution is developed around a parallel organization scheme, as shown in Figure 6-7. Site features strongly influence the orientation of the scheme. Two parallel spines are developed; one for academic and staff spaces, and one for vocational training spaces. Requirements for parking space and for service and access to the vocational training area, make use of a two-story academic building desirable. Access to the main parking area runs between the academic and vocational training buildings.

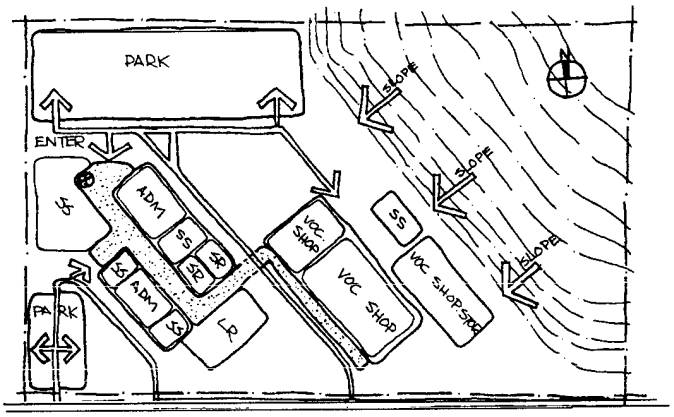
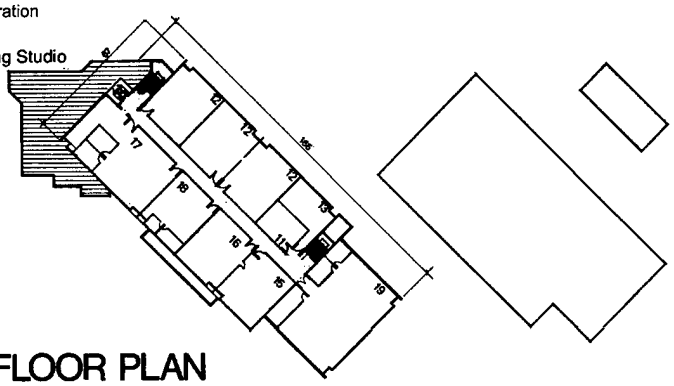


Figure 6-7 Basic Spatial Organization-Scheme B-1

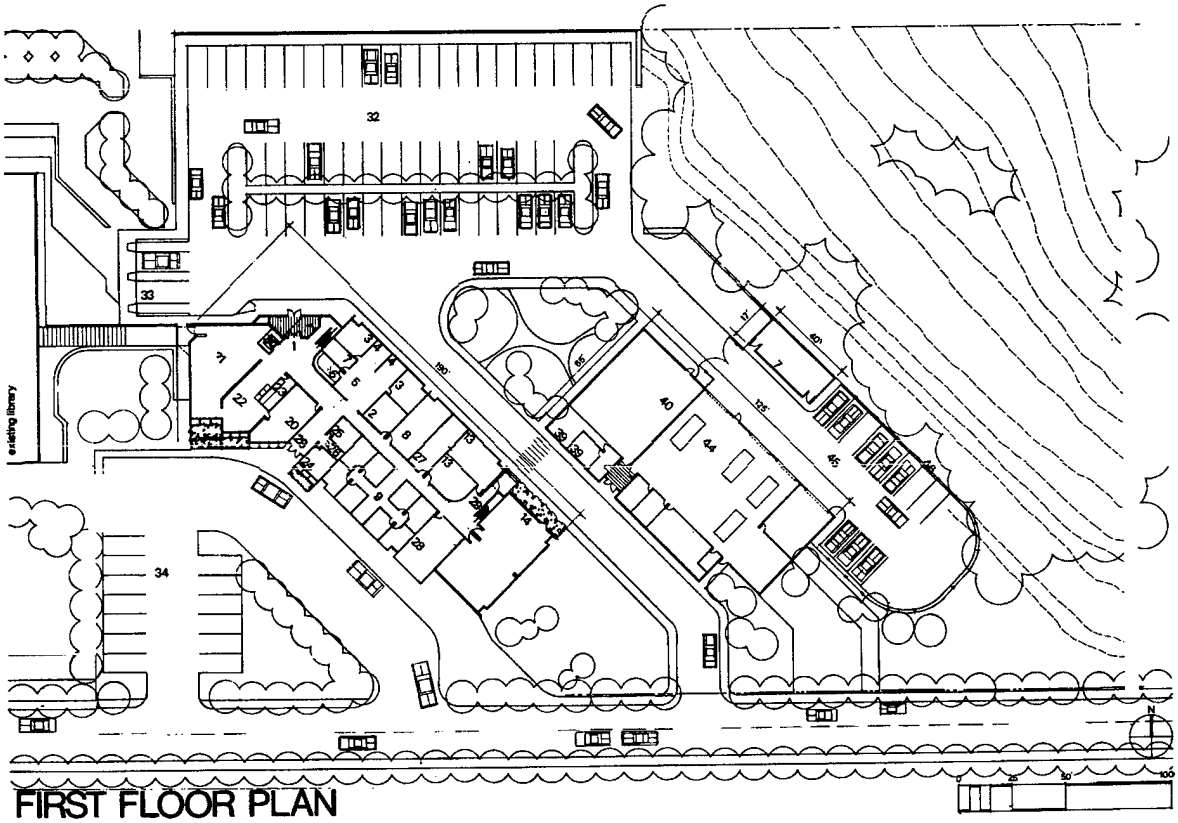
(2) Example Plan. As shown in Figure 6-8, the main entrance to the academic building is from the main parking area. Principal staff spaces have been placed adjacent to the main and secondary entrances for control purposes. The vending area and lounges are also located in this area which is the primary node for vertical circulation. Counselors are located on the ground floor in proximity to the administrative area and the Director's office. Lecture room and seminar rooms are located at one end of the ground floor adjacent to the circulation flow between the academic and vocational training buildings. The other academic spaces are located on the second floor. The primary pedestrian

6-5 EXAMPLE DESIGN-SCHEME B-1 FOR 10,500 MILITARY STRENGTH (cent'd)

1. Entrance
2. Director
3. Administrator
4. Clerk
5. Typists
6. Information and Registration
7. Storage
8. Training Aids Preparation
9. Counselors
11. Rehearsal/Recordi ng Studio
12. Classroom
13. Seminar Room
14. Lecture Room
15. MOS Library
16. Self-Paced Instruction
17. Science Lab
18. Language Lab
19. Testing Room and Related Facilities
20. Staff Lounge
21. Student Lounge
22. Vending Area
23. Vending Storage
24. Men's Toilet
25. Women's Toilet
26. Janitor's Closet
27. Receiving Room
28. General Storage
29. Secondary Entrance
30. Elevator
32. Student and Staff Parking
33. Handicapped Parking
34. Registration & Visitor Parking
39. Shop Toilets
40. HVAC Shop
44. Auto Body Repair Shop
45. Auto Storage
46. Fence



SECOND FLOOR PLAN



FIRST FLOOR PLAN

Figure 6-8 Example Plan Scheme B-1– Education Center for 10,500 Military Strength

6-5 EXAMPLE DESIGN-SCHEME B-1 FOR 10,500 MILITARY STRENGTH (cont'd)

entrance to the vocational training shops is from the access road with service access on the opposite side. The basic 25 x 30 ft module has again been used throughout the academic and staff building with the larger 30 x 50 ft module used for the vocational training shops. The lecture room and testing room have been stacked due to relative size. The diagonal orientation of the ACES Center to the existing library creates a strong visual relationship between the two buildings. To strengthen that relationship, the lounge spaces have been oriented on the same axis as the library with a covered pedestrian link between.

6-6 EXAMPLE DESIGN–SCHEME C FOR 21,000 MILITARY STRENGTH

a. SITUATION. This project is located on an installation in the southeast United States. The new ACES Center will replace a number of classroom facilities which are scattered in temporary structures throughout the installation. It will also supplement a vocational training unit which is located within a 10-minute walking distance. The site designated on the master plan is generous in size, with a primary road defining the site on the south. The long dimension of the site (approximately 750 ft) runs parallel to the road.

The use of the Center is projected to be high. Current enrollment in ACES programs is almost 1000. The projected semester enrollment will be approximately 1750. The ACES Center will operate on a 44 hour week, including evening and Saturday classes.

b. PLANNING DATA.

(1) Authorized Space Allowance. A 21,000 person (military strength) installation is allowed (Table 2-1) up to 38,080 GSF, excluding mechanical space, for an ACES Center.

(2) Staffing. Authorized staffing is shown in Table 6-11.

Table 6-11 Example Staffing for Military Strength of 21,000

Type	No. of Authorized Staff
Director	1
Administrator	3
Clerk	4
Typist	4
Registrar	1
Counselor	17
TOTAL	30

6-5 EXAMPLE DESIGN-SCHEME B-1 FOR 10,500 MILITARY STRENGTH (cont'd)

(3) Gross Space Requirement. Table 6-12 summarizes the space required for this example.

Table 6-12 Tabulated Space Requirements and Occupant Capacity Example for Military Strength of 21,000

	Load	SF
Staff Spaces		
Director	1	200
Administrators (3)	3	450
Clerks (4)	4	400
Typist (4)	4	300
Registrar	1	100
Information and Storage	—	350
Counselors (17)	17	1,525
Reference	.	150
Total Staff Capacity	30	3,475
Academic Spaces		
Classrooms (4)	100	3,000
Lecture Room	53	1,500
Seminar Rooms (5)	65	1,875
Self-Paced Instruction	20	750
MOS Library	9	750
Language Lab	22	750
Science Lab	25	1,500
Testing Room (2 classrooms)	50	1,905
Rehearsal/Recording Studio	6	375
	350	12,405
Vocational Training Spaces		
Auto Mechanics Shop	20	5,850
Masonry Shop	20	4,150
Communications/Industrial Electronics Shop	20	2,525
	60	12,525
Total Student Capacity	410	
Support Spaces		
Staff Lounge		240
Student Lounge		875
Vending Area		475
Training Aids Preparation		635
Toilets – 286 men (500 SF) 95 women (200 SF)		700
Toilets – Vo. Training Area 54 men (415) 6 women (115)		530
Receiving/Gen. Storage		795
Janitor Closet		160
		4,410
Net Total		32,815 NASF
Net to Gross Space at 15%.		4,925
Gross Total (maximum allowable target – 38,080 GSF)		37,740 GSF
Mechanical Space		400

6-6 EXAMPLE DESIGN-SCHEME C FOR 21,000 MILITARY STRENGTH (cont'd)

c. DESIGN SOLUTION

(1) Basic Spatial Organization. This solution is developed around the parallel organization scheme. Two linear spines are created parallel to each other, following the long dimension of the site as shown in Figure 6-9. The academic-staff area is developed along one spine and the vocational training shops are located along the other. Parking is located near the main entrance to the academic spaces with service access extending to the north side of the vocational training spaces.

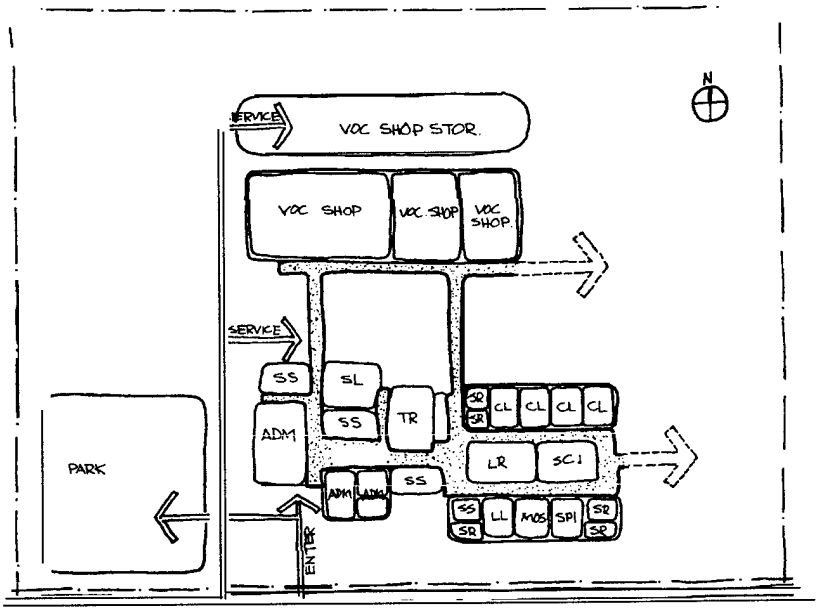


Figure 6-9 Basic Spatial Organization — Scheme C

(2) Example Plan. The academic-staff building is organized into two basic functional zones as shown in Figure 6-10; staff and support spaces are grouped around an interior court at the main entrance and academic spaces are grouped around the lecture room and science lab. The student lounge and the toilets are located near the main entrance and adjacent to the primary circulation flow between the academic building with the vocational training shops. The student lounge is oriented toward an outdoor terrace and landscaped instructional area between the two parallel buildings. Visual experiences are created in the circulation spaces of the academic-staff building by use of curved walls, proportional variation, and natural greenery to establish focal points and visual rhythm. The basic 25 x 30 ft module is used for the academic-staff spaces with the 30 x 50 ft module utilized for the vocational shops.

6-6 EXAMPLE DESIGN-SCHEME C FOR 21,000 MILITARY STRENGTH (cont'd)

1. Entrance
2. Director
3. Administrator
4. Clerk
5. Typists
6. Information and Registration
7. Storage
8. Training Aids Preparation
9. Counselors
11. Rehearsal/Recording Studio
12. Classroom
13. Seminar Room
14. Lecture Room
15. MOS Library
16. Self-Paced Instruction
17. Science Lab
18. Language Lab
19. Testing Room and Related Facilities
20. Staff Lounge
21. Student Lounge
22. Vending Area
23. Vending Storage
24. Men's Toilet
25. Women's Toilet
26. Janitor's Closet
27. Receiving Room
28. General Storage
29. Secondary Entrance
31. Landscaped Court
32. Student and Staff Parking
33. Handicapped Parking
35. Service Area
36. Terrace
39. Shop Toilets
41. Communications/industrial Electronics Shop
42. Masonry Shop
43. Auto Mechanics Shop
45. Auto Storage
46. Fence

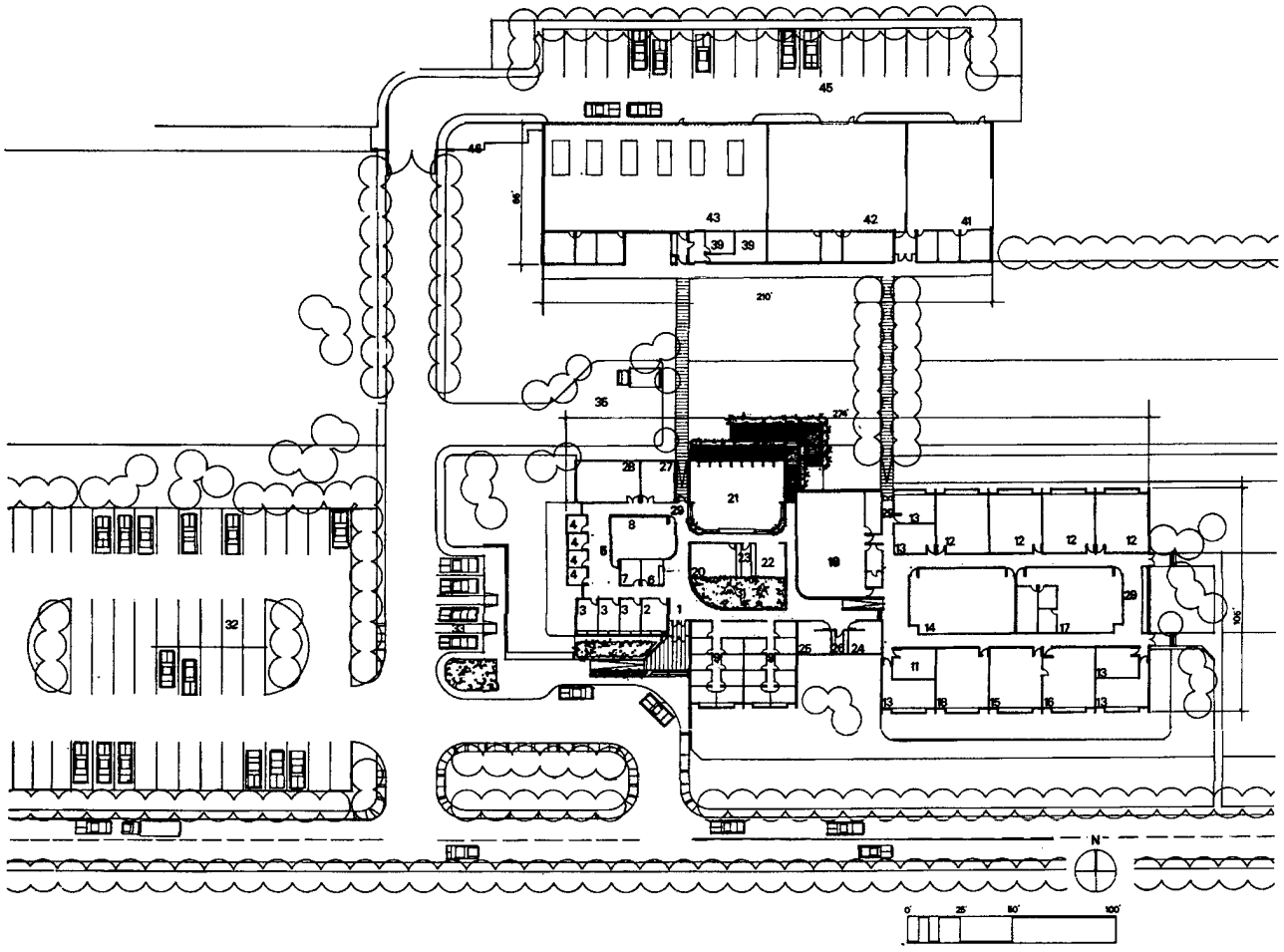


Figure 6-10 Example Plan–Scheme C – Education Center for 21,000 Military Strength

6-7 EXAMPLE DESIGN–SCHEME C-1 FOR 21,000 MILITARY STRENGTH

a. SITUATION. The mission, size and location of this ACES Center project are the same as described in Scheme C, however, the site designated on the master plan is relatively small in size and triangular in shape. The site is bounded by a wooded area on the north and the primary road on the west. There are excellent views to the west.

b. PLANNING. The authorized space allowance and staffing, and the projected enrollment and usage of the ACES Center are the same as determined in Scheme C; the space requirements are the same as those indicated in Table 6-12.

c. DESIGN SOLUTION.

(1) Basic Spatial Organization. This solution is developed around a dispersed organization scheme as shown in Figure 6-11. The limited site area makes use of a two-story academic building desirable. Topographic features and views, in addition to site configuration, influence the spatial organization in this solution. The academic building is placed parallel to the road to take advantage of the views. Vocational training shops are developed on a spine perpendicular to the academic building. Main entry to the ACES Center is serviced by a loop road on the south. Service access to the vocational training area is provided by a road along the north side and center of the site.

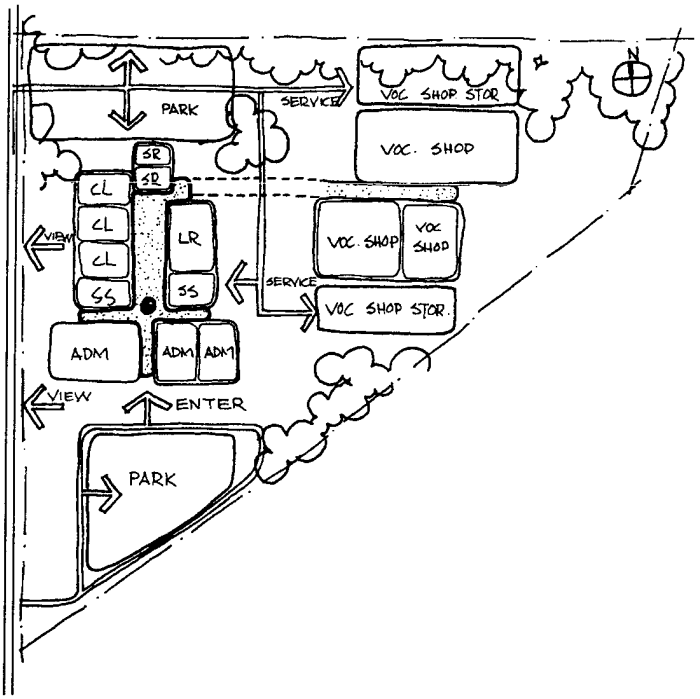


Figure 6-11 Basic Spatial Organization–Scheme C-1

6-7 EXAMPLE DESIGN-SCHEME C-1 FOR 21,000 MILITARY STRENGTH (cont'd)

(2) Example Plan. Two distinct structures have been developed as shown in Figure 6-12. A two-story academic building is developed around a high interior court and vertical circulation nodes with classrooms, staff offices, lounges and balcony-terrace located to take advantage of the view. Vocational training shops are organized along a double-loaded corridor with the ancillary functions, including toilets with showers and lockers, located on either side of the corridor. The basic 25 x 30 ft module is used in the academic building with the larger testing room, and its related spaces, stacked over a similiarized module containing the counselor offices. The 30 x 50 ft module is used for the vocational training spaces.

6-7 EXAMPLE DESIGN-SCHEME C-1 FOR 21,000 MILITARY STRENGTH (cont'd)

1. Entrance
2. Director
3. Administrator
4. Clerk
5. Typists
6. Information and Registration
7. Storage
8. Training Aids Preparation
9. Counselors
11. Rehearsal/Recording Studio
12. Classroom
13. Seminar Room
14. Lecture Room
15. MOS Library
16. Self-Paced Instruction
17. Science Lab
18. Language Lab
19. Testing Room and Related Facilities
20. Staff Lounge
21. Student Lounge
22. Vending Area
23. Vending Storage
24. Men's Toilet
25. Women's Toilet
26. Janitor's Closet
27. Receiving Room
28. General Storage
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33. Handicapped Parking
35. Service Area
36. Terrace
39. Shop Toilets
41. Communications/industrial Electronics Shop
42. Masonry Shop
43. Auto Mechanics Shop
45. Auto Storage
46. Fence

6-7 EXAMPLE DESIGN-SCHEME C-1 FOR 21,000 MILITARY STRENGTH (cont'd)

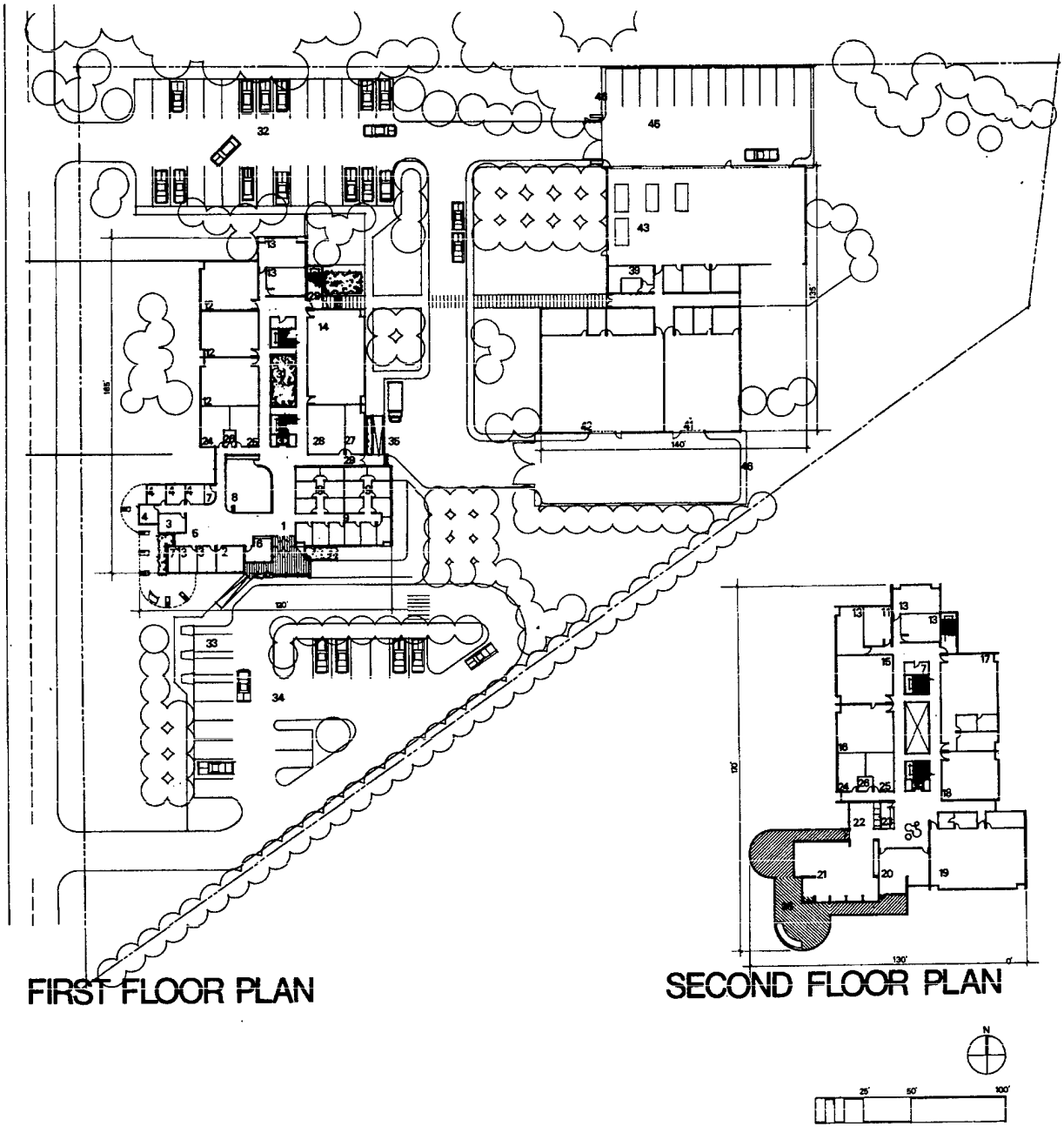

Figure 6-12 Example Plan—Scheme C-1—Education Center for 21,000 Military Strength

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DESIGN GUIDE

AUTO CRAFTS CENTERS

ENGINEERING DIVISION
MILITARY CONSTRUCTION DIRECTORATE
OFFICE OF THE CHIEF OF ENGINEERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC 20314

AUGUST 1976

Foreword

DG 1110-3-126
August 1976

The Design Guide (DG) series has been established to replace material previously issued under the standard design medium by the Engineering Division, Military Construction Directorate, Office of the Chief of Engineers, U.S. Army.

This guide governs the design of Army Auto Crafts Centers.

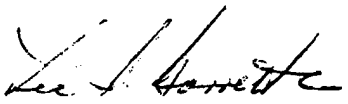
The guide is intended not only to state basic criteria, but also to provide a means by which the user of the guide can apply the criteria in individual ways to respond to local requirements. This guide is applicable to all new construction projects for Army Auto Crafts Centers and projects involving modernization of existing facilities.

Detailed development of this guide was under the direction of the Special Projects Section, Structures Branch of the Engineering Division. Major parts of the material contained herein are based on the results of an architectural services contract with the firm of McLeod Ferrara Ensign, Washington, D. C., under Contract No, DACA 73-73-C-0008. The functional requirements in this guide have been developed in conjunction with, and approved by, the Recreation Directorate of the U.S. Army Adjutant General Center, (DAAG-RE),

Distribution of this guide is limited. Additional essential copies are available from the OCE Publications, Depot, 890 South Pickett Street, Alexandria, Virginia 22304.

Users are invited to send comments and suggested improvements to HQDA (DAEN-MCE-A), Washington, D.C. 20314.

FOR THE CHIEF OF ENGINEERS:



LEE S. GARRETT
Chief, Engineering Division
Directorate of Military Construction

Contents

CHAPTER 1
Introduction

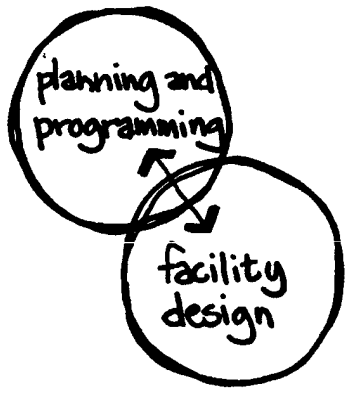
1-1 Purpose

a. This guide contains design criteria for Army Auto Crafts Centers which are in some instances referred to as Automotive Self-Help Garages. The term Automotive Self-Help Garage will be used only when preparing budget documents, DD forms 1391 which summarize project requirements for the Military Construction, Army (MCA) Program and for nonappropriated funded projects as stated in AR 28-1 and AR 230-1.

b. The primary purpose of this guide is to provide criteria for design personnel who prepare and evaluate project designs. This guide also provides general guidance for installation personnel and Corps of Engineers field offices in planning and programming project requirements.

c. In addition, it is expected that facility managers will find this guide useful in planning improvements or in better utilizing existing Auto Crafts Centers or other suitable facilities.

d. This guide is directed toward improving early design decisions and toward the development of realistic, cost-effective spaces in conjunction with the regulations and criteria references below. It should be used in the preparation of project development brochures, project data forms, design analyses and drawings.



Guide Use

1-2 Primary References

a. DOD 4270.1 -M, Department of Defense *Construction Criteria Manual.*

b. AR 28-1, *Army Recreation Services.*

c. AR 415-10, *General Provisions for Military Construction.*

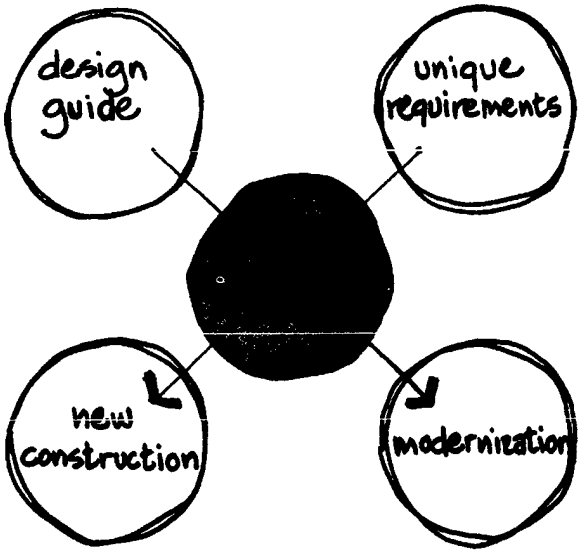
d. AR 415-15, *MCA Program Development.*

e. AR 415-17, *Empirical Cost Estimates for Military Construction.*

f. AF 415-20, *Project Development and Design Approval.*

9. E R -1110-345-700, *Design Analysis.*

1-3 Scope



Application

a. This design guide is applicable to all new construction projects for Army Auto Crafts Centers. It is also applicable, as general guidance, to projects involving the modernization or conversion of existing facilities.

b. While this guide is the basic design criteria document for Auto Crafts Centers, it is not intended to provide all of the information required for successful preparation of project designs. Additional information must be obtained from the installation pertaining to the unique requirements of the users and the locational constraints and opportunities of the site.

c. Maximum space allowances for Auto Crafts Centers are discussed in Department of Defense Construction Criteria Manual 4270.1-M, Chapter 3. These allowances are based on the authorized projected military population of the using installation. Military population is defined as the military strength plus ten percent of the dependent population and ten percent of the retired military personnel living in the area. Although an Auto Crafts Center of 17,000 square feet which serve a military population of 15,000 to 20,000 was chosen to illustrate the criteria contained in the guide, the criteria contained herein are applicable to all sizes of facilities.

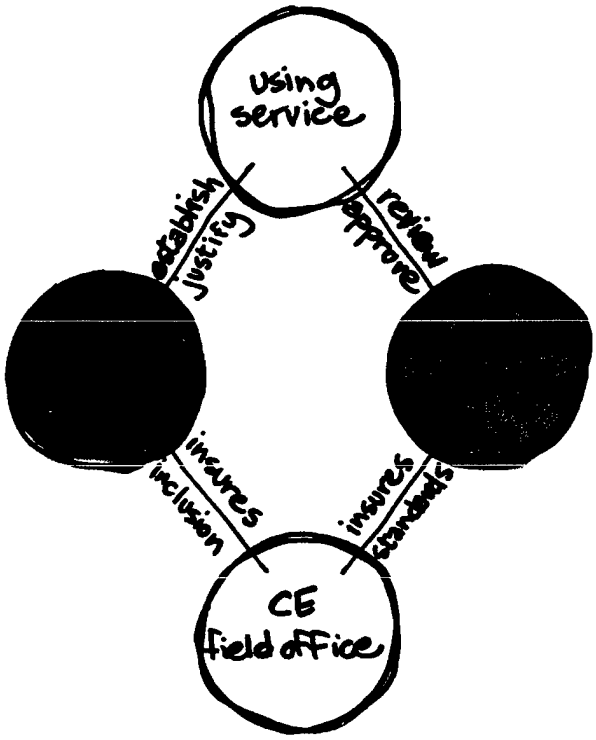
d. Example designs are provided in Chapter 5 for both a new facility of 17,000 square feet and for converting a facility as found space containing 20,000 square feet.

1-4 Emphasis

a. Special emphasis shall be placed on the quality of architectural design since it vitally affects the longevity, economics, usefulness and efficiency of Auto Crafts Centers. In addition to considerations of life-cycle economy and functional efficiency, a prime requirement of the architectural design shall be the attractiveness of both the interior and exterior facilities. An overall interior design scheme should be developed in conjunction with the building design of all new facilities and of major alterations to existing facilities. Items that must be procured using other than construction funds should be programmed early and scheduled for procurement as appropriate.

b. As part of the overall design, a users information book should be assembled to help provide instructions on maintaining and operating the facility to maximum advantage. The book should cover major design intentions for the utilization of the facility and its interior spaces, and related information concerning environmental controls, mechanical facilities and housekeeping in general.

1-5 Responsibilities



Project Responsibilities

a. The using service for individual MCA projects is defined in AR 415-10 and its responsibilities are outlined in AR 415-20. The using service is responsible for:

(1) Establishment of specific project functional requirements within the parameters contained in this guide.

(2) Justification of functional requirements falling outside the parameters of this guide.

(3) Obtaining installation action to gain site approval if the project is not sited in accordance with the approved master plan.

(4) Preparation and submission of project data, DD Form 1391, in accordance with AR 415-15.

(5) Preparation and submission of the project development brochure required by AR 415-20.

(6) Review and approval of concept design drawings to certify compliance with functional requirements.

b. The Corps of Engineers field office responsible for design will insure that:

(1) Functional requirements of the using service are incorporated into the design.

(2) Requirements of the using service are in accordance with the criteria contained herein.

(3) Major deviations from this guide as requested by the using service are explained in the project design analysis.

(4) Quality standards for overall design are emphasized as stated herein.

(5) Assemblage of user information is complete, and is provided, together with the completion records required by AR 415-10, to the using service.

CHAPTER 2
General Considerations

2-1 Automotive Craft Activities

a. Automatize repair is an authorized activity within the Army Arts & Crafts program. Due to the nature of this activity, a separate specialized facility is authorized for each installation.

b. Basic automotive service operations are performed in Auto Crafts Centers. In addition, facilities are provided for instructional programs, club meetings, administrative tasks, tool issuance, and storage, and limited sales of parts.

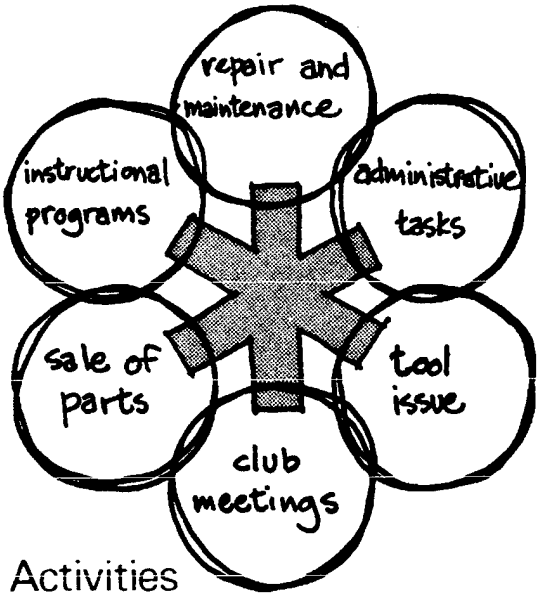
c. Repair and maintenance activities can be categorized by work performed on the following components:

(1) Engines
(2) Fuel Systems
(3) Electrical Systems
(4) Suspension Systems
(5) Braking Systems
(6) Clutch/Drive Line Systems
(7) Transmission
(8) Differentials
(9) Heating, Ventilating and Air Conditioning Systems
(lo) Bodies and Fenders

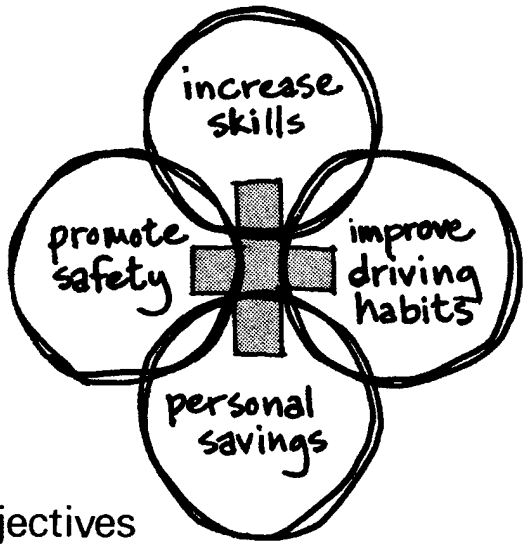
d. Specifically, activities are oriented toward the constructive repair and maintenance of personal vehicles such as cars, trucks, trailers, motorcycles and bicycles. Vehicle owners must perform their own repairs with only guidance from supervisors. Because of high demands on facilities, priority is given to those activities which can be completed in a relatively short time. Shop supervisors are required to limit the scope of a project to the ability of the individual. Therefore, many highly specialized operations are not generally performed, and long term repairs are authorized on a space available basis. Some storage space must be provided for inoperative vehicles, but many installations require disposition of abandoned vehicles, supplies, and personal property left over 30 days.

e. Generally the larger Auto Crafts Centers have tools and equipment available to accomplish the following:

(1) Motor tune-up, engine overhaul and cleaning
(2) Wheel balancing and tire repairs
(3) Steering and front-end alignment
(4) Brake repair and adjustments
(5) Differential adjustment and repair
(6) Fuel, cooling, exhaust, ignition and electrical system work
(7) Clutch and transmission repair
(8) Oil changing and lubrication
(9) Headlight adjustments
(lo) Body repair and spray painting
(11) Cutting and welding parts
(12) Air conditioner repair



Activities



Objectives

(13) Cleaning and repairing car interiors
(14) Installation of accessories
(15) Battery charging
(16) Car washing

f. Automotive craft activities also go beyond the repair of an individual's vehicle. The Army encourages a diversified program with instruction in maintenance, repair, safety and good driving habits. Supervisors organize car clinics, road rallies, gymkhanas, obstacle course competitions, safety inspections and demonstrations.

g. Classes of instruction in auto mechanics, anti-pollution control, upholstery, air conditioning, welding and body work may also be conducted in conjunction with the Army General Education Development (G.E.D.) Program. These classes may utilize the auto repair facilities for practical laboratory experience necessary to develop skills and to meet certain Military Occupational Speciality (MOS) requirements.

2-2 Auto Crafts Centers

a. One Auto Crafts Center is the authorized minimum requirement for each installation. The establishment of additional auxiliary auto crafts centers must be justified by degree of interest, size of installation, and the dispersal of the installation population. Authorization to establish and operate an auxiliary facility will be predicated on availability of funds, supervisory personnel, and the maximum authorized space allowance as established by the Department of Defense *Construction Criteria Manual, 4270.1M.*

b. Facilities can be functionally divided into the following areas: general repair and tune-up stalls; muffler and tire shop; lubrication stalls; body shop; spray paint booth; steam cleaning stall; machine shop and welding area; classroom space; tools and parts storage; off ice space; utility and service areas.

c. Since participants will include dependents and retirees, Auto Crafts Centers must be accessible to and usable by the physically handicapped. Refer to ER 1110-1-102, *Design for the Physically Handicapped,* for guidance.

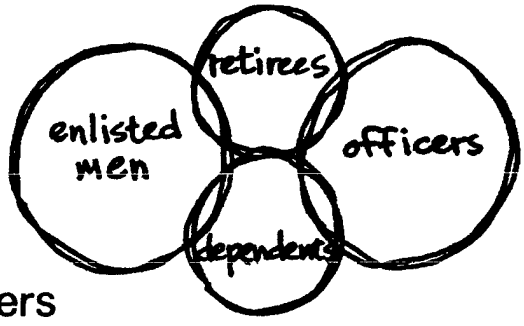
2-3 Participants

a. The Auto Crafts Center is frequently one of the most popular of all arts and crafts facilities. The primary users are assigned military personnel, both officers and enlisted men. Others who are generally eligible to be shop patrons on a space available basis are military retirees and dependents of assigned personnel, whose vehicles are registered with installation authorities.

b. The maximum number of participants to use the center at any one time is limited by the amount of work space available and the amount of space for instruction and demonstrations. Since operating procedures generally require that vehicle owners must perform their own repairs with possible help from friends who are eligible patrons, the number of actual users at any one time is relatively small. For a thirty-four stall facility, a reasonable estimate of the maximum number of users performing repairs at one time might be sixty to seventy-five. Classroom participation could add an additional thirty patrons.

c. Many factors influence the number of participants in automotive craft activities, but one of the most important is the interest that can be generated in a diversified program. Efficient scheduling for a rapid turnover of projects is also necessary for maximum participation. Usually, participation will be proportional to the size of the facilities readily available to the military community. It is especially important that auto craft facilities be open on weekends, holidays, evenings, and times when military personnel are off duty. These are the times of maximum participation.

d. Administrative personnel may include a shop supervisor, one automatize repair instructor for every four stalls in operation, a tool issue/sales attendant, and a few part-time or visiting classroom instructors.

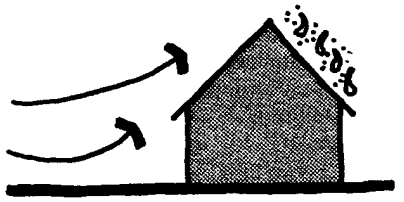


Users

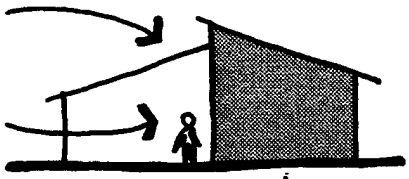
2-4 Climatic Influences

a. Climatic variations play an important part in the building design of Auto Crafts Centers and the selection of materials and systems used therein. Current definitive drawings are based only upon the design approach of each auto stall having direct access to the exterior through large overhead garage doors. This practice, especially in colder climates, should be reevaluated in future projects in view of current energy conservation policies. Frequent use of garage doors lets in cold air which increases energy usage and creates uncomfortable working conditions. On the other hand, it is often desirable to operate with the doors open in warm weather. This one example illustrates the influence climate can have in the design of this building type and reinforces the requirement that careful analysis involving various cost and function trade-offs be made in each instance:

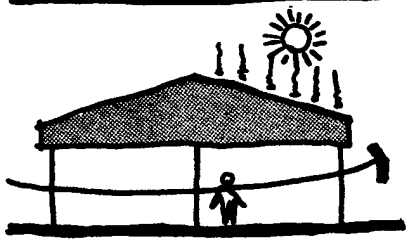
b. In mild climates, many auto craft activities can be performed outdoors or under covered canopies. Within authorized space allowances, covered work areas are calculated at one-half of the square footage of equal sized enclosed spaces and advantage can be made of this to increase the total amount of allowable work space. Outdoor spaces should also be designed with local conditions in mind. For example, wind driven sand can negate the usefulness of a covered outdoor work area which is improperly oriented or shielded from the prevailing winds.



(1) Severe climate dictates compact building forms.



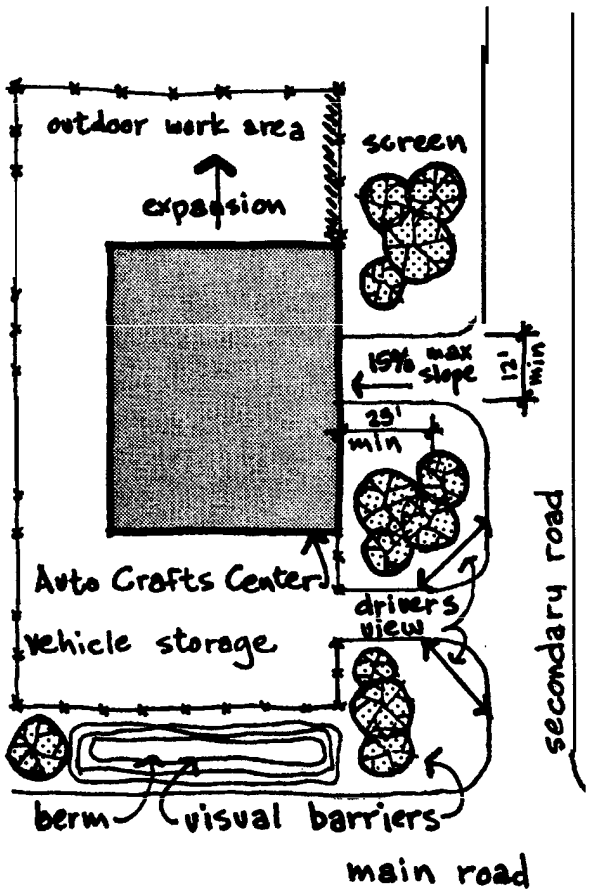
(2) Temperate climate permits the use of natural ventilation and light.



(3) Warm climate permits maximum use of covered exterior work areas in addition to indoor space.

Building Orientation Factors

2-5 Siting



Site Considerations

a. Installation master plans are guides for future land development and indicate specific locations of proposed facilities. They evolve from an analysis of requirements for housing, service activities, and military operations. Ecological considerations, utility and transportation modes, as well as natural characteristics of the terrain are some of the factors which contribute to the formulation of the plan.

b. Unlike other activities of the arts and crafts program, Auto Crafts Centers need not be located close to other social/recreational facilities. Past attempts to combine auto craft facilities with Arts and Crafts Centers have proved unsuccessful, and the practice is now discouraged.

c. The nature of many operations performed in Auto Crafts Centers is largely light industrial, and it is therefore appropriate that these facilities be sited near compatible activities. Auto Crafts Centers with their stored vehicles, security fences, and sometimes noisy operations often tend to become nuisances in residential or community support areas, although this does not have to be the case. Care should be taken in site selection, site development, architectural treatment, and the use of man-made and natural barriers to prevent this from happening.

d. Where ever possible, the vehicular entrances to the site should not be directly from a major thoroughfare, For safety, the distance between any shop entrance and the street should be at least 25 feet. One-way driveways are preferred with a minimum width of 12 feet and a straight entrance into the garage. Sharp turns near entranceways cause accidents. Parking aprons and driveways should slope gradually away from the building for good drainage, but a slope of 15% should be the maximum for entrances. However, by scoring the concrete with grooves, in a "V" shaped pattern, the entrance will have good drainage and less slippage.

e, Patron parking should be provided for a minimum of one-half the vehicular capacity of the shop. This is particularly important for garages geared to a quick turnover of services. The parking area should be convenient to the shop entrance, yet not interfere with car circulation.

f. In addition to patron parking, a paved outdoor work and vehicle storage area should be provided. This area may be used to park inoperative vehicles and store bodies and chassis awaiting parts as well as to provide outdoor work space. Outdoor work and storage areas can be an unattractive nuisance and should be fenced and screened for security and aesthetic reasons.

2-6 Site Development

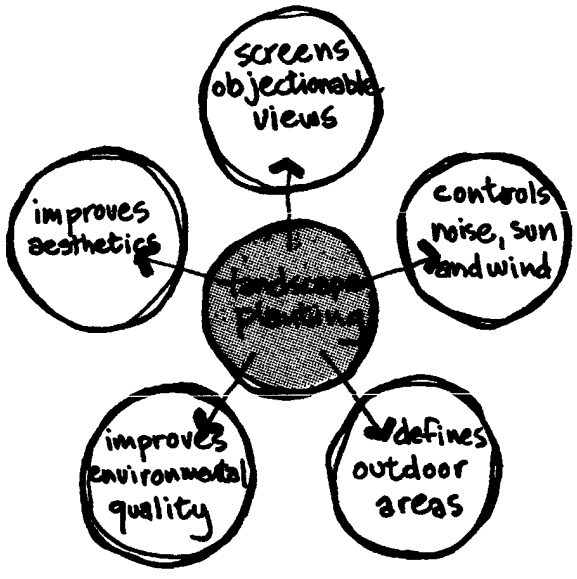
a. Garages have an unfortunate and often undeserved reputation as being potential eyesores. if for no other reason, landscaping can play an important part in refuting this premise. But apart from beautification, foliage and other site improvements can serve a much more functional purpose. Landscape planting can define outdoor work areas, direct the flow of traffic, muffle noise, screen objectionable views, control sun and wind, and conserve energy. Planting adds to the environmental qualities of an area by controlling erosion, absorbing carbon monoxide and dioxide, and discharging oxygen.

b. Landscape designs should be as maintenance-free and vandal proof as possible. However, landscape planting should not be so minimal or so protected that it defeats its functional and aesthetic purposes.

c. Paving materials, benches, and other landscaping structures should be selected for durability together with their other qualities of texture, scale, shape and color.

d. Desirable plants are those that are most resilient or defensive in nature, with tough leaves or bark, or fine thorns. In addition to evergreens, selections should be made from those that blossom in spring, bear foliage or fruit in the summer, and change color in the fall to produce a continuing interest.

e. Improper location of planting can also produce hazards by obstructing the views of drivers and pedestrians. Particular care to avoid this condition should be taken because of the inherent danger of frequent movement of vehicles.

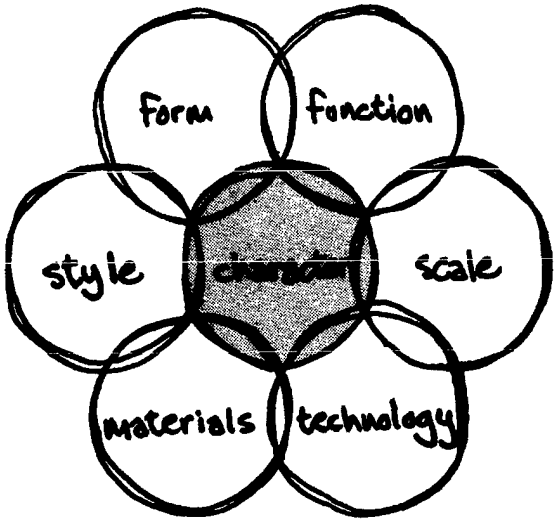


Landscape Functions

2-7 Architectural Character

a. Auto Crafts Centers should be accepted for what they are; structures that house the repair and maintenance of 20th century machines. It seems appropriate that their design should reflect the industrialization and technology of the society that mass produces the vehicles themselves. In addition, these facilities should also reflect the fact they are craft shops. They are places where an individual renews and tunes to peak efficiency his own vehicle within the limits of his ability. Auto Crafts Centers should not be cold, impersonal or overbearing. Careful consideration of color, scale, and texture can do much to enhance the character of these buildings.

b. The adoption of an industrial design approach does not mean that the solution need have an ugly industrial quality. Aesthetically undesirable design products usually result from insensitivity and lack of understanding of good design which is often justified in the name of economy and expediency. Harmonious materials, careful detailing, screening of unsightly areas, and imaginative use of color can all contribute to aesthetic quality. The building should exemplify- desirable characteristics of local construction practices, with materials chosen on the basis of availability, economy, durability and capability to generate visual interest through color and texture.



Character Determinate

2-8 Interior Design

a. Interior design features must be developed in coordination with the architectural design. All features of the building relative to the interior design, whether they are furnished and installed as part of the construction contract or provided later by the using service, must be developed as an overall scheme. Graphic design and signage should be included as part of the overall design to identify activities and facilitate functional effectiveness.

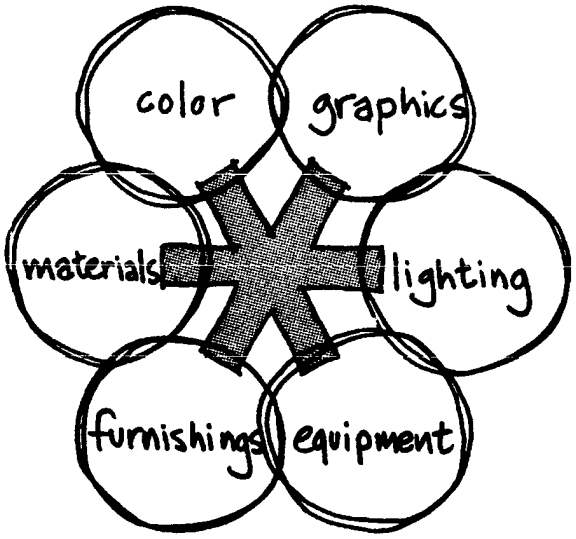
b. Use of color in Army facilities is limited to a practical number selected from Federal Standard 595A, Colors. General guidance for color selection is provided in TM 5-607-7, *Colors for Buildings.* Color should be used to stimulate human physical and emotional reactions and to enhance the overall functionality of the Auto Crafts Center. In critical seeing areas, glare, brilliant colors and great brightness differences, both in the lighting system and in the color of walls, floors, furnishings and equipment should be avoided.

c. The effectiveness of an automotive craft program depends on the availability of suitable equipment, tools and supplies. The equipment and furnishings in the buildings can be categorized as follows: those used in the testing and repair of vehicles; those used as instructional aids; and the general furniture and accessories used in the support areas such as the classrooms and office.

d. The *Catalog of Army Arts and Crafts Program Equipment* contains illustrations and specifications for equipment for the Army Arts and Crafts Program. Essential Facilities and Equipment for Program Operations. Arts and Crafts Program, lists essential equipment and budget prices. However, none of these sources cover all program items and costs, and specifications should be obtained from three major sources:

(1) Army schedules for government furnished standard items as indicated by the various commands.
(2) Schedules from GSA and Federal Prison Industries.
(3) Commercial supply firms.

e. The proper spacing of equipment and adequate power supply is essential for the safe operation of the shops. The maximum number of tools is governed by the amount of area required for safe operation. Islands of space around most power tools is essential for safety. These requirements are identified in Chapter 3.



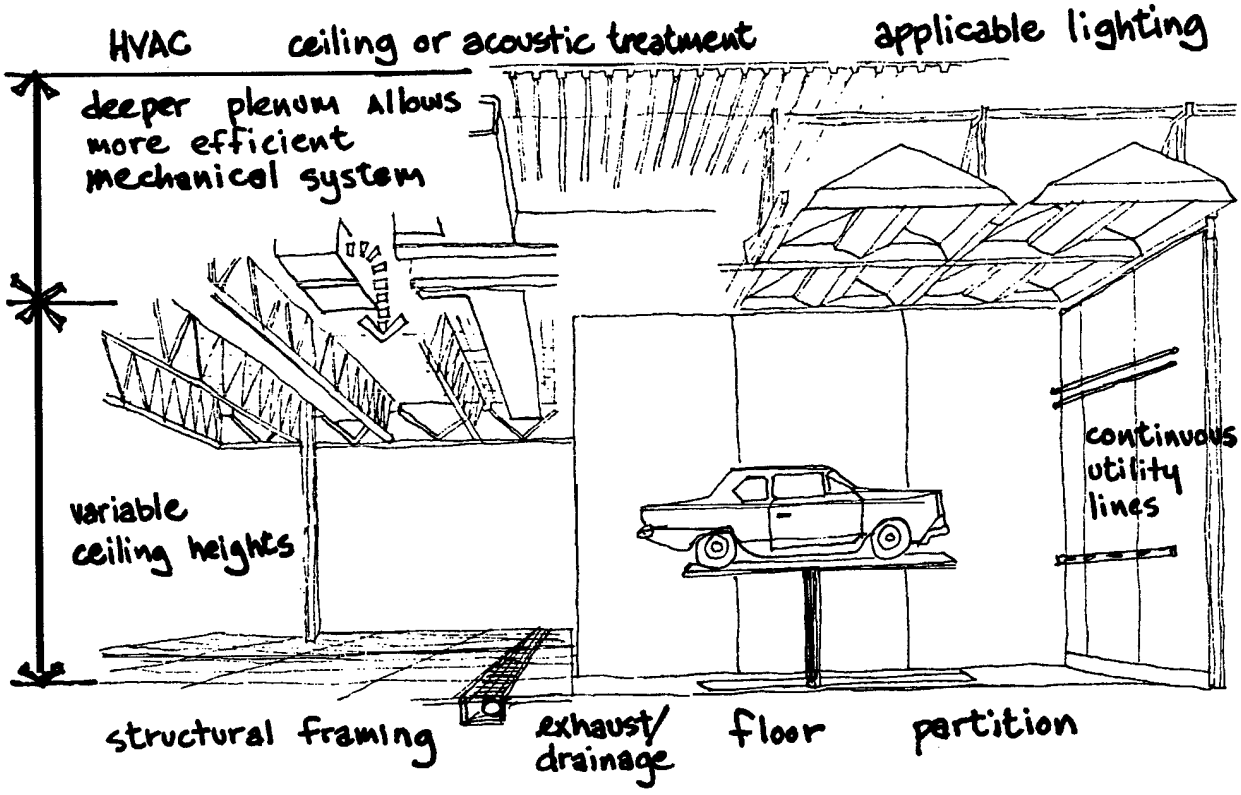
Interior Design Elements

2-9 Systems Building

a. Systems building is the, application of modern production techniques to the building process. While not universally applicable, systems building is expanding in the construction industry.

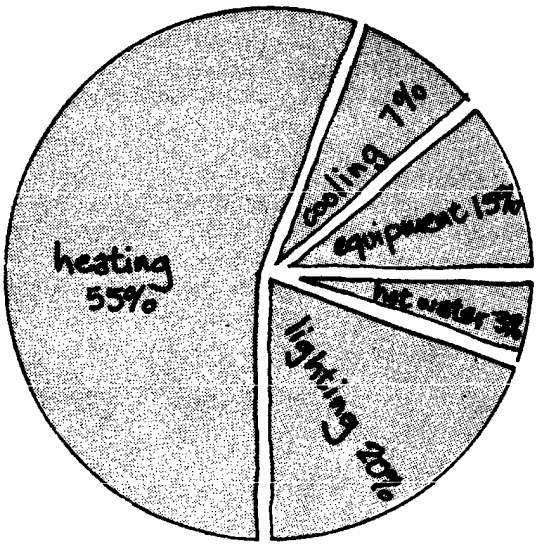
b. Systems built facilities are composed of sub-systems which typically include structural framing systems, lighting and ceiling systems, heating, ventilating and air-conditioning systems, and interior partitioning systems. The best examples of systems built facilities offer economy of both time and money committed to construction, a high degree of quality control, and maximum flexibility of space.

c. In many cases systems building is applicable to military construction, and its feasibility should be considered, particularly for Auto Crafts Centers. Building systems selected should be those which are most economical and suitable based on comparative cost studies for the building.

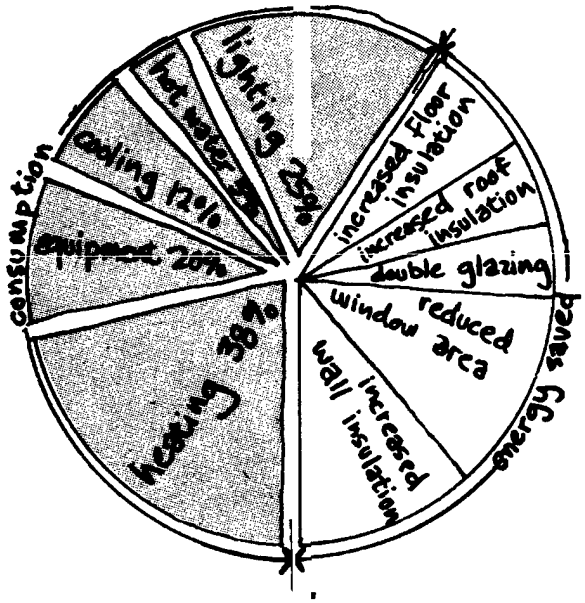


Sub-Systems

2-10 Energy Conservation



Typical Annual Energy Consumption



Possible Savings In Annual Energy Consumption

a. With decreasing energy sources, conservation must be practiced in all facilities at military installations. New construction offers a variety of methods to conserve energy. The skillful exploitation of local climate conditions, topography, trees, solar exposure, and other natural features, combined with building orientation, compact building shapes, and wall shading, offer opportunities for energy conservation. The simple consideration that each side of a building may require different treatment depending on its exposure is often overlooked in designing an energy efficient building.

b. Auto Crafts Centers, with their numerous exterior overhead doors, are often wasteful of energy for heating and cooling. However, in warm climates large openings help provide a comfortable interior environment without the need for mechanical ventilation or cooling. Thus energy conservation can be important when considering the basic design solutions at a particular installation. Another obvious area to consider in energy conservation is the selection of mechanical and electrical systems and their control. Night time control settings and automatic regulation of power equipment can produce significant savings. The amount of building insulation, particularly in the roof, is another important factor, and heat recovery devices must be considered.

c. Long-range (life cycle) costing which compares initial capital improvement costs with extended operational costs is a valid method to determine the most efficient balance between building and mechanical systems.

d. Lighting intensities should conform to the minimum levels recommended by the latest edition of *Illurination Engineering Society Lighting Handbook.* Where practical, lighting will be designed for specific local tasks instead of providing uniform general loads.

e. The upper chart on this page shows the proportion of typical annual energy consumption for an auto crafts center. The second chart shows a possible 40% savings savings in total consumption due to various conservation techniques, resulting in a reapportionment of energy consumption. Conservation techniques when used at the time of construction provide a real savings during the life of the facility in both resources and operating funds.

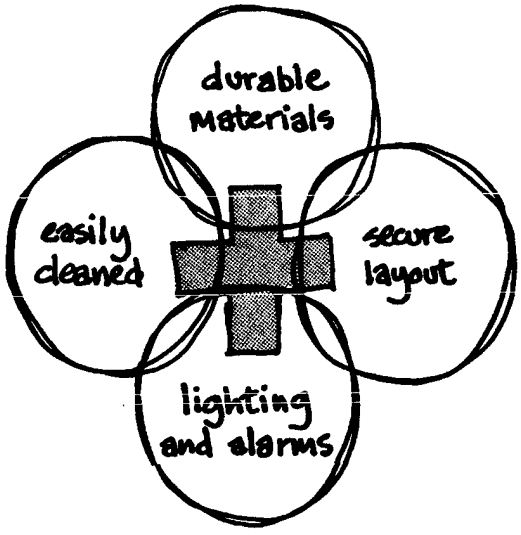
2-11 Minimizing Maintenance and Vandalism

a. Auto Crafts Centers are subject to a high incidence of vandalism, pilfering, accidents, and heavy wear and tear. This is due partly to the fact that moving vehicles can be destructive, and their very weight and mobility are potential dangers. The process of car repair also involves the use of gasoline, grease, toxic fumes, acids, and other substances which soil and create hazards.

b. It is particularly important to exercise care in the selection of materials, finishes, and pieces of equipment that will stand up to heavy use and can be easily maintained. The use of residential type overhead garage doors is a case in point, Except in the most dire economic circumstances they should not be used, because they are not designed to withstand such service and their hoisting mechanisms frequently break down.

c. Security considerations are equally important. Shops contain tools, parts, and automobiles that are attractive temptations to a significant number of people. Points of entrance should be lighted and designed to be easily seen from the outside by security patrols and easy to control internally by the staff. Outdoor vehicle storage areas should be fenced and provided with appropriate lighting.

d. Vandalism is an increasing social problem nearly everywhere, including military installations, and must be considered when designing an Auto Crafts Center. The layout of the building, the elimination of hard to supervise areas, the use of durable materials and security lighting are important in alleviating this problem.



upkeep Factors

2-12 Found Space In Existing Buildings

There are facilities on many installations that no longer serve their designated purposes. Finding and adapting space in such buildings to other functions may be a solution to the space needs of an Auto Crafts Center. However, a careful analysis of functional suitability and economics is required before such a decision can be reached.

b. In order to determine the validity of using found space the planner should, in the preliminary stage, prepare an inventory of existing buildings that are available for the intended use. Any existing facility considered for long term use as an Auto Crafts Center should, as a first principle, fit within the land-use parameters of the installation master plan. An analysis of the suitability of a particular facility for its proposed adaptive use should follow a progressively more detailed evaluation. A primary test of suitability should include:

(1) Location and accessibility – An otherwise suitable building which is in the wrong location in not a viable solution unless other factors can be introduced.

(2) Site Size – The site must be adequate for its proposed function which may also include building additions.

(3) Comparability of Functions – The Auto Crafts Center must be compatible with adjacent facilities,

(4) Availability of Utilities – An advantage of found space may be the cost savings resulting from existing utilities. Conversely, lack of basic services may be grounds for rejecting such space.

c. Facilities that appear to meet the foregoing primary test can be surveyed to determine the feasibility of converting or remodeling the buildings. The survey of an existing structure should follow an analytical format to permit value judgments of its suitability.

d. There are a number of evaluation techniques in use today. The best generally accepted methods rely on a numerical scoring system to arrive at an index of economic and functional acceptability. All methods are necessarily subjective to a greater or lesser extent, and the judgment and experience of the surveyor is an important factor.

e. The chart on page 19 illustrates one analytic format which is suitable for the level of complexity of an Auto Crafts Center. It establishes a numerical framework within which the intrinsic value of a potential "found space" building can be approximately determined,

f. The 12 major site elements and 15 major building elements listed in column 1 are assigned a percentage of the

Survey and Evaluation of Existing Buildings

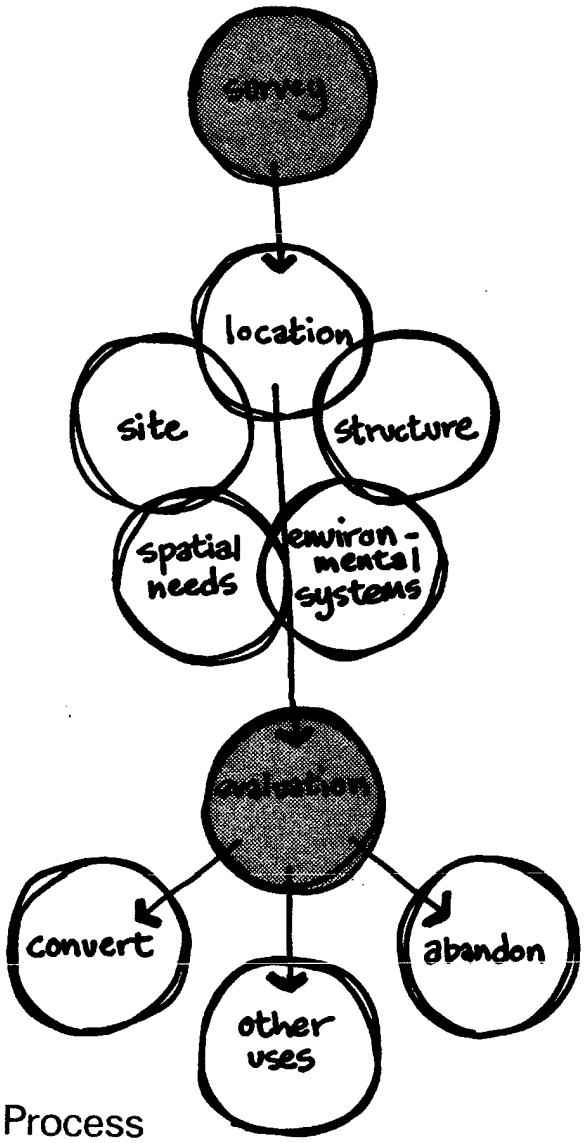
1. SITE AND BUILDING ELEMENTS	2. PERCENTAGE VALUE OF ITEM	3. PERCENTAGE ACCEPTABLE IN THIS BUILDING	4. ACTUAL VALUE FACTOR
LOCATION SURVEY			
1 AVAILABILITY	[30]	[80]	[24.0]
2 PUBLIC TRANSPORTATION	[5]	[50]	[2.5]
3 PRIVATE TRANSPORTATION	[7]	[80]	[5.6]
4 PEDESTRIAN ACCESS	[3]	[70]	[2.1]
5 SAFETY	[5]	[60]	[3.0]
6 COMPATIBILITY	[10]	[75]	[7.5]
SUBTOTAL	[60]		[44.7]
SITE SURVEY			
7 SANITARY SEWER	[10]	[100]	[10.0]
8 ELECTRIC SERVICE	[10]	[50]	[5.0]
9 WATER SERVICE	[10]	[30]	[3.0]
10 SIZE	[5]	[50]	[2.5]
11 ROADS, WALKS, PARKING	[3]	[30]	[0.9]
12 LANDSCAPING	[2]	[10]	[0.2]
SUBTOTAL	[40]		[21.6]
TOTAL	[100]	TOTAL V.F.%	[66.3]*
ARCHITECTURAL SURVEY			
1 SIZE	[5]	[80]	[4.0]
2 EXTERIOR WALLS	[8]	[70]	[5.6]
3 ROOF	[3]	[30]	[0.9]
4 FLOOR	[4]	[90]	[3.6]
5 CEILINGS	[3]	[60]	[1.8]
6 PARTITIONS	[7]	[10]	[0.7]
7 WALL FINISHES	[2]	[0]	[0]
8 FIXED EQUIPMENT	[4]	[0]	[0]
9 MISCELLANEOUS	[4]	[0]	[0]
SUBTOTAL	[40]		[16.6]
STRUCTURAL SURVEY			
10 EXCAVATION AND SUBSTRUCTURE (FOOTINGS)	[5]	[100]	[5.0]
11 SUPERSTRUCTURE (FRAME, COLUMNS)	[2]	[100]	[2.0]
12 HORIZONTAL FRAME (JOISTS, BEAMS, SLABS)	[18]	[90]	[16.2]
SUBTOTAL	[25]		[23.2]
ENVIRONMENTAL SYSTEMS SURVEY			
13 HEATING, VENTILATING, AND AIR-CONDITIONING	[20]	[50]	[10.0]
14 PLUMBING	[5]	[75]	[3.8]
15 ELECTRICAL	[10]	[65]	[6.5]
SUBTOTAL	[35]		[20.3]
TOTAL	[100]	TOTAL V.F.%	[60.1]*

* See paragraph 2-12.h

cost for a complete building. The percentages listed are typical and taken from construction cost indices. They may vary depending on local or special factors.

g. In most cases, a visual inspection by a knowledgeable surveyor, can result in a numerical value being assigned to the percentage acceptable for each element. Those elements that are entirely acceptable are assigned a value, or "feasibility factor" of 100. Those that require modifications are given lower numbers as are judged appropriate. These are entered in column 3.

h. Column 4 provides an "Actual Value Factor". It is determined by multiplying columns 2 and 3, and dividing by 100. The total of all actual value factors produces an overall value factor which offers a useful yardstick in approximating the relative worth of an existing facility compared to a new structure. One rule of thumb is that if the overall value factor is over 50% it would be reasonable to pursue in greater detail the economic feasibility of converting its space. Simplified, that means, the existing facility in its present state is worth half that of a new physical facility. A sample evaluation is shown on the chart.



Process

i. If the proposed facility has passed this test of acceptability, the next step is to establish preliminary cost estimates for bringing the building to a state of usefulness for its new function. This usually requires the preparation of conceptual design drawings and an analysis of the usefulness of the converted space. Experience has shown that if a building is converted to another use, it will usually have to be larger than a building designed specifically for this use, because of inherent problems of flexibility and structural limitations.

j. Following the preparation of a program, a conceptual design response to it, and a preliminary cost estimate, some valid judgments can be made on the advisability of converting space. Obviously, if the cost of the conversions are high in ratio to the Overall Value Factor the economics of conversion are highly suspect.

k. The initial cost of construction or of conversion should not be the only economic criteria for decision making. Life-cycle costing is a method of determining the economic feasibility of facilities taking into account the useful life expectancy of a converted facility against a new one. It recognizes that initial cost is only one, and by no means the largest, expense in a building's life. Operating and maintenance costs are also considered. By amortizing all costs over the life expectancy of a facility, a comparative economic evaluation prorated on an annual basis can be established. This then can form the foundation for economic decisions.

i. In chapter 5 of this Design Guide, an example of converting a common warehouse structure into an Auto Crafts Center is illustrated.

m. Another way of evaluating criteria for found space is through a checklist. The chart on this page is a simplified tabulation of the facility requirements from Chapter 3 of this guide, and is intended to be used as a criteria checklist. A number or specific requirement is written in the top half of many of the squares. If the space being evaluated meets these criteria enter a checkmark or numerical rating in the lower half to indicate how well the requirement is met. Where the darker shading exists in the upper half of the square, there is a requirement without a specific quantity. Again a checkmark or numerical rating should be placed in the lower half. If the space being evaluated does not meet the requirements then a "X" or a zero should be placed in the lower half of the square. Where the lighter shading exists there is no requirement. This checklist is a simple means of evaluation and can be easily used to analyze found space with respect to functional requirements.

Criteria Checklist for Evaluation

ACTIVITY \ REQUIREMENT	Programmed Area	Number of Stalls	Minimum Ceiling Height	Structural Appropriateness	Required Egress	Building Code Requirements	Access to Exterior Areas	Acoustical Treatment	Lighting Level	Power Required	Ventilation	Exhaust System	Vacuum	Water	Floor Drains	Gas	Compressed Air	
General Repairs and Tune-ups	3112	17	12'		2				70 FC	115/220								
Muffler and Tire Shop	1728	6	15'		2				70 FC	115/208								
Lubrication Stalls	1728	6	15'		2				70FC	115								
Body Shop	864	3	15'		2				70FC	115/208								
Paint Booth	288	1	12'		2				70FC	115/208								
Steam Cleaning Stall	288	1	12'		1				50 FC									
Machine and Welding Shop	2000		12'		2				70 FC	115/208								
Office and Storage Areas	1500		10'		2				30 FC	115								
Classroom	650		10'		1				30 FC	115								

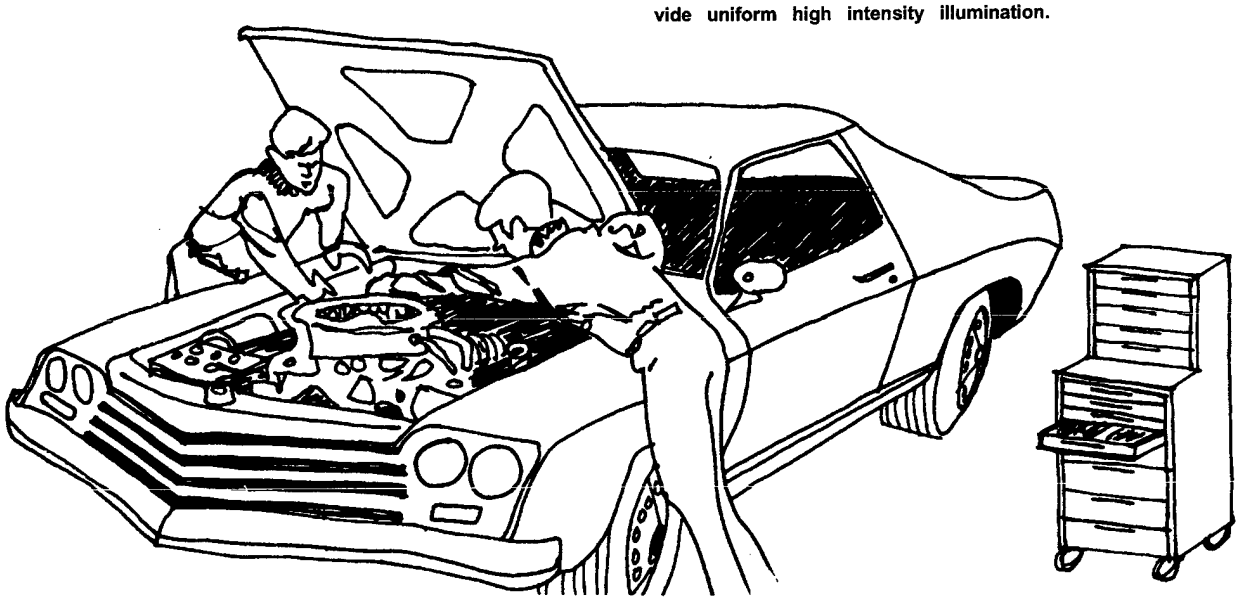
CHAPTER 3
Functional Space Requirements

3-1 General

a. The Department of Defense *Construction Criteria Manual* 4270.1-M establishes the maximum space allowances for Auto Crafts Centers based upon the military population of the installation and the overall maximum allowance for the entire facility of 500 square feet per automobile repair stall. The example illustrations in this guide are for installations with military populations of 15,000 to 20,000. A facility of this size provides 34 stalls and an authorized gross area of 17,000 square feet exclusive of mechanical equipment rooms.

b. The general repair and tune-up stalls, the muffler and tire shop, and the lubrication stalls should be designed to facilitate frequent movement of vehicles. These functions are compatible to the extent that they can all be performed within a common maintenance area.

c. Auto body work stalls should be separated from other work areas because of the dust and noise produced. A separate ventilation system adequate to remove injurious dust and vapors is required. Paint spray booths also require physical separation and independent exhaust systems. Prefabricated spray booths are becoming more popular on military installations and are usually better than those built on site. These may be installed within the garage itself or free standing in an outdoor work area. They are often modular and available in a wide range of sizes. Units must meet stringent design requirements of fire underwriters to confine any accidental blaze. Most booth manufacturers have attempted to position their diffusers and light sources to remove overspray and provide uniform high intensity illumination.

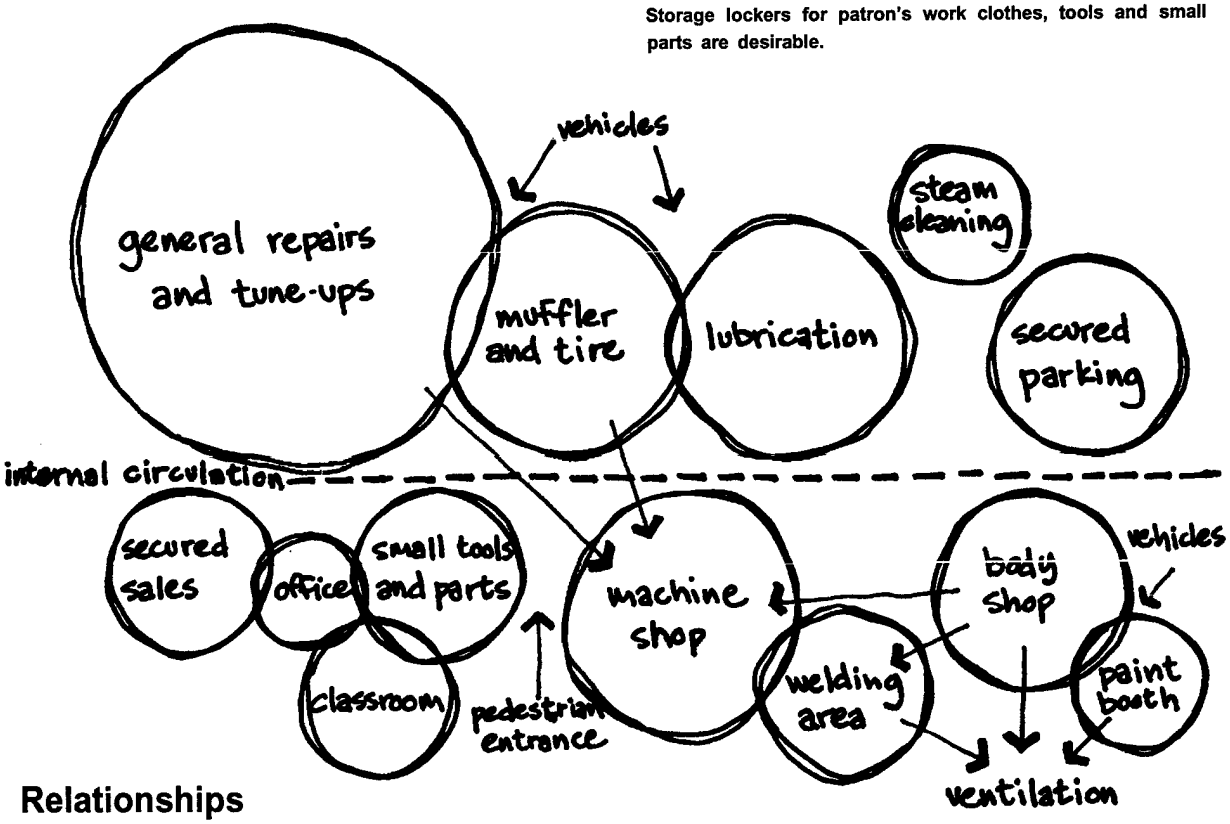


d. Steam cleaning stalls should be separated from dry activity areas. Steam cleaning can also be done outdoors, and ideally the equipment may be located for both indoor and outdoor use. Concrete pads should be provided to eliminate deterioration of asphalt paving.

e. The machine and welding shop should be convenient to the repair areas and storage areas. A separate ventilation system is required for welding booths.

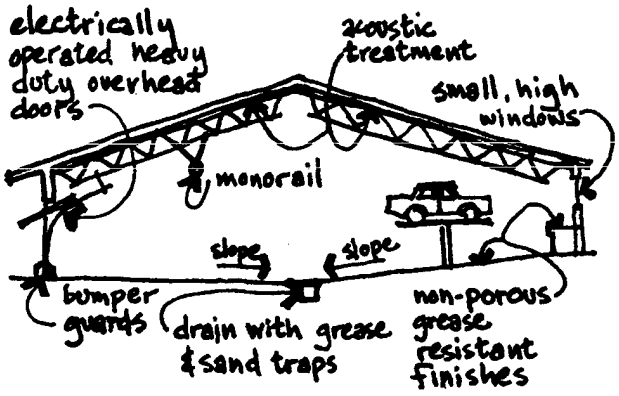
f. The classroom is used for formal instruction and club meetings. A small library may be included. Provisions should be made for the use and storage of visual aids, models and other training materials,

g. The office, sales, tool issue and storage areas should be designed as a unit so they may be controlled from a centrally located supervisor's station. The method of storing and issuing tools varies, but the options include individual tool kits, open tool panels which are sometimes portable, and controlled tool issue rooms. In addition to storage requirements for tools, storage of flammable material such as paint and welding tanks must be provided in enclosures away from the building and from vehicles. Storage lockers for patron's work clothes, tools and small parts are desirable.



Relationships

3-2 Physical Requirements



Treatment

a. Most shop areas can be treated as typical industrial space. Floors should be impervious concrete sloped to adequate floor drains or gutters with special grease and sand traps. Wall surfaces should be durable, impervious to water and grease, and easily washable. The overhead roof structure can be exposed. A minimum ceiling height of 15 feet is necessary for areas with hydraulic lifts and it is frequently more economical to provide this headroom universally throughout the structure. Acoustical materials on the underside of roofs help to reduce noise to a comfortable level. A monorail, with a capacity of not less than one ton, is very desirable along at least one side of the shop. This requires reinforcement of the overhead structural system.

b. Modern automotive shop practice discourages the use of large numbers of windows. Wall space is at a premium for functional purposes. Natural light is not a necessity and the reduction of glazing makes the garage easier to heat and cool. Utility lines ideally are located exposed along walls above work counters and equipment where they can be easily changed or expanded, and where portable equipment can be easily connected,

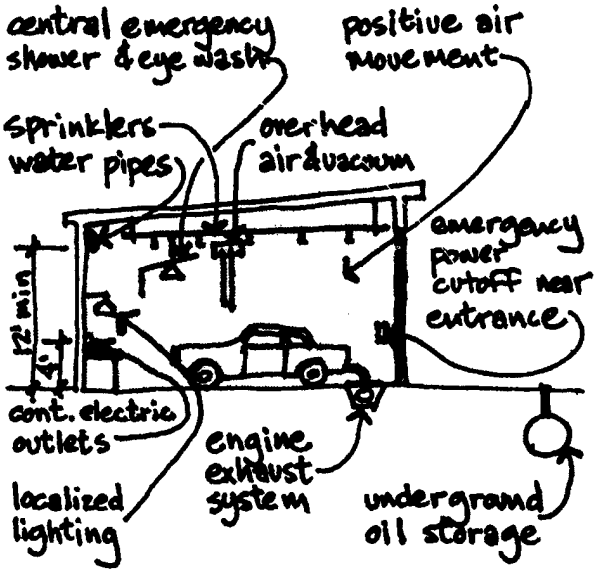
c. The number of overhead vehicle doors depends on the size and layout of the garage. A high quality heavy duty door is important; it is recommended that each door be no less than 12 feet wide by 12 feet high. Residential type doors which have been installed in many facilities do not stand up well under the intensive use common to these garages. Electrically opened doors are preferable if they can be budgeted. They are essential where the design limits the number of openings so that the traffic through them is very heavy. The lower panels of the doors should be solid with vision panels above for safety. Heavy duty bumper guards should be used around all vehicle openings and on exposed wall corners.

d. The classroom is basically an open area and can be treated as typical instructional space. Floors should be provided with grease resistant tiles.

3-3 Technological Requirements

a. An engine exhaust system is essential. It is recommended that this be at least 8 inches in diameter and installed under floors, preferably in trenches with removable steel covers for maintenance, Flexible conduits from outlets at floor level can be connected to tailpipes or engine. If underground ducts are impractical or too expensive, an overhead exhaust system may be used. This means that flexible connections must be brought down from above at convenient locations. A forced convection fan with automatic control and visual indicator is necessary to reduce pressure in the system at all times.

b. Positive air movement through the work areas must be provided to minimize carbon monoxide dangers. Local climate conditions will influence heating, cooling, and ventilation requirements. However, heating, air conditioning and ventilation shall conform to the applicable portions of current editions of NFPA No. 88B, ASHRAE Handbooks and DOD *Construction Criteria Manual*



Services

4270.1 -M. Consideration should be given to such items as comfortable floor level temperatures, hot air compensation for heat loss at exterior doors, and zone heating controls.

c. In the body work area, machine shop and welding booths, separate ventilation systems which remove dust and filings should be provided. Paint booths also require their own ventilation systems, and a hood with independent exhaust should be placed over battery charging benches. Air conditioning may be provided for the classroom and off ice as permitted by the DOD *Construction Criteria Manual 4270.1-M.*

d. An underground storage tank for waste engine oil is the most satisfactory storage solution if a pump removal service is available at the installation.

e. Hot and cold water supplies are necessary to toilet rooms and service sinks in the shops. Electric chilled water drinking fountains are very desirable in each shop. At least one emergency eye wash and shower, centrally located, is essential.

f. Water pipes should run underground or along walls at least 12 feet overhead so they will not be readily damaged. Oil and sand interceptors are required on floor drainage. There are stringent regulations on some installations concerning water discharged into sewage systems and an early check of the requirements should be made when planning a facility. A long interceptor gutter about 15 inches wide covered by sectional metal grating is a good solution to the washdown problem in the shops.

g. Compressed air outlets should be provided at the work counters. In addition to portable fire extinguishers, shops should be sprinklered.

h. Electric outlets should be located at approximately 10 foot intervals along the walls. Power should be 115 V, 60 cycles, single phase, A.C. and also a 6 volt and 12 volt D.C. supply at work benches is important. Heavy duty fans, air compresses and other equipment require 208 volt, three phase A.C. current. Motors, switches, and lights in spray booths must be vaporproof. Circuits should be limited to about four outlets, and master emergency "stop" switches should be provided for each circuit.

3-4 Furnishings and Equipment

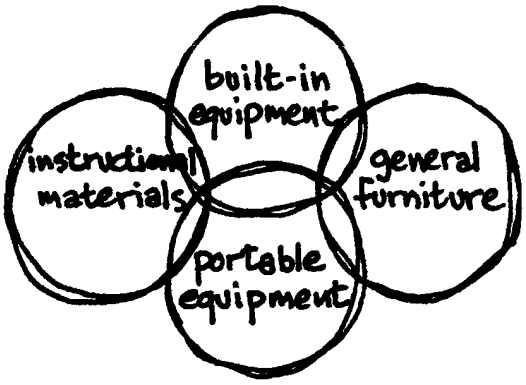
Automotive design is characterized by frequent model changes which affects service procedures and maintenance equipment. Auto Crafts Centers should therefore be equipped for future adaptations as new procedures occur. A case in point is the emission control testing equipment that is necessary in response to the latest federal and state requirements.

b. The following list of service equipment is not intended to be all inclusive but rather to give designers a general idea of built-in and portable items that must be considered:

Paint spray booths, hydraulic lifts, drill presses, bench grinders, two-station arc welding tables, wheel alignment service center, one ton mechanical jacks, two ton hydraulic jacks, transmission and differential lifts, monorail system, one ton differential chair hoist, tire changers, air compresses, parts cleaner, steam cleaner, engine analysis system centers, portable parts cabinets and mechanics chests, steel topped work counters, metal lathes, brake lathes, armature lathes, battery chargers, motor repair stands, wheel balances, and hand tools, both metric and standard.

c. In addition to service equipment, the classroom requires the following instructional materials:

Demonstration table, classroom tablet arm chairs, table for upholstery work, sewing machine, glass demonstration motor with transmission, visual aid demonstration panels, instructor's desk and a supervisor's desk, portable work counters, chalkboard, projection screen, lockable file drawers, and small parts storage cabinets.



Types

Suggested Quantity of Equipment

Equipment Items	Number of Automobile Stalls				
	4	8	12	16	30
Bench Grinder	1-3	1-3	2-4	3-6	6-10
Bench Buffer	1	1-2	2-4	2-4	2-6
Spark Plug Cleaner-Tester	1	1-3	3-6	3-8	4-8
Steel Work Benches	4-6	8-10	12-16	16-20	20-30
2-Station Welding Table	1	2-3	2-4	4-6	4-8
Hydraulic Lift	1	1-2	1-4	1-6	6-8
Alignment Service	0-1	1-2	1-4	1-6	1-6
Bumper Jacks	1-2	2-3	2-6	4-8	8-12
Tire Changer	1	1-3	1-4	1-6	3-8
Metal Lathe	0	0	1-2	1-3	2-4
Brake Lathe	0	0-1	1-2	1-3	2-4
Armature Lathe	1	1-2	1-3	1-6	2-8
Arbor Press	0	0-1	1	1	2
Vacuum Cleaner	1	1	2	2	4
Battery Charger	1-2	1-3	2-4	2-6	4-8
Safety Stands	2-4	4-6	6-8	12-18	30-40
Vacuum Fuel Pump	1	1-3	1-4	1-6	1-8
Tachometer	1-2	1-3	1-4	1-6	1-8
Micrometer	1-2	1-3	1-4	1-6	1-8
Headlight Adjuster	0-1	1-3	1-4	1-6	1-8
Portable Power Tools					
Polisher/Drill/Sander	1-3	1-4	1-6	2-12	20-25
Machinist Vise	1-3	2-4	3-10	4-12	10-20
Blacksmith Anvil	1-3	1-3	2-4	2-6	10-12
Air Compressor	1-2	1-3	1-4	1-6	2-12
Spray Booth	0-1	0-1	1-3	1-4	2-10
Lube Unit	1-2	1-3	2-6	2-8	6-10
Scope Analyzer	0-1	0-2	1-3	1-6	2-8
Soldering Unit	1-2	1-3	1-6	1-8	3-10
Welding Unit	0-1	0-1	1-3	1-6	2-8
Portable Crane	0-1	1-2	1-3	1-4	2-6
Valve Refacer	0-1	0-1	1-3	1-4	2-6
Steam Cleaner	0-1	0-1	1-2	1-3	2-4
Transmission/Differential Lift	1-2	1-3	1-4	2-6	4-6
Motor Repair Stand	1-3	2-4	2-6	2-8	4-10
Parts Cabinet	1-4	1-6	1-8	1-10	3-12
Washer Parts	0-1	0-1	1-3	1-4	2-6
Radiator Testing/Repair	0-1	1-3	1-4	1-6	2-8
Wheel Balancer	0-1	1-3	1-4	1-6	3-10
Impact Wrenches	1-2	1-3	2-4	2-6	6-8
Cylinder Sets	1-2	1-4	2-6	2-8	4-10
Puller Sets	2-3	4-6	9-11	13-18	26-32
Hand Tool Sets	Various	Various	Various	Various	Various

3-5 Summary of Space Allocations

a. Department of Defense *Construction Criteria Manual 4270.1* -M establishes space allowances for the entire Auto Crafts Center at a maximum of 500 square feet per automobile stall. It should be recognized that discretion must be exercised in applying this space allocation to meet the needs of a particular installation. For instance, an outdoor covered work area is computed as one-half the square footage of a similar sized space fully enclosed. Regions of the country with climates which permit extensive use of outdoor covered work areas can take full advantage of this factor. Conversely, in very cold climates it makes little sense to adopt a design which is drafty, uncomfortable, and difficult to heat becuase of a large number of overhead vehicle doors. However, the type of design more common in larger commercial garages, which has a limited number of vehicular entrances also requires more space for maneuvering of cars inside. In such instances, an economic analysis should be made to balance the added cost of constructing extra space for internal vehicular circulation against the reduced cost of operation, the possible savings in perimeter walls, and the improvements in comfort of the participants.

b. The following tables show typical space allocations for two types of Auto Crafts Centers. Table A shows the allocation of space for a facility with vehicular circulation on the outside of the building and with an overhead access door for each auto stall. Table B shows the allocation of space in the same size facility, however, access to auto stalls is by vehicular lanes inside the building. The implications of providing vehicular circulation within the building can be readily seen by comparing the total number of auto stalls provided.

c. An example design for a new facility of 34 stalls and 17,000 square feet is provided in Chapter 5.

TABLE A
External Vehicular Circulation

SPACE	UNIT AREA	ACTIVITY AREA
GENERAL REPAIRS & TUNE-UPS		
17 stalls at 12' x 28'	336	5,712
MUFFLER & TIRE SHOP		
6 stalls at 12' x 24'	288	1,728
LUBRICATION STALLS		
6 stalls at 12' x 24'	288	1,728
BODY SHOP		
3 stalls at 12' x 24'	288	864
PAINT BOOTH		
1 stall at 12' x 24'	288	288
STEAM CLEANING STALL		
1 stall at 12' x 24'	288	288
MACHINE & WELDING SHOP		
Shop area	1,600	
Welding area	400	2,000
OFFICE & STORAGE AREAS		
Office space	100	
Small tools and parts	700	
Issue area	100	
Secured sales	600	1,500
CLASSROOM		
Classroom	600	
Storage room	50	650
SERVICE AREAS		
Mens' toilet & locker	240	
Womens' toilet & locker	150	
Wash areas	200	
Vending areas	50	
Custodial	70	710
TOTAL NET AREA		15,468 square feet
CIRCULATION		600 square feet
CONSTRUCTION		932 square feet
GROSS BUILDING AREA		17,000 square feet
TOTAL NUMBER OF AUTO STALLS		34

TABLE B
Internal Vehicular Circulation

SPACE	UNIT AREA	ACTIVITY AREA
GENERAL REPAIRS & TUNE-UPS		
12 stalls at 12' x 24'	288	3,456
MUFFLER & TIRE SHOP		
5 stalls at 12' x 24'	288	1,440
LUBRICATION STALLS		
4 stalls at 12' x 24'	288	1,152
BODY SHOP		
3 stalls at 12' x 24'	288	864
PAINT BOOTH		
1 stall at 12' x 24'	288	288
STEAM CLEANING STALL		
(Located outside)	---	---
MACHINE & WELDING SHOP		
Shop area	1,600	
Welding area	400	2,000
OFFICE & STORAGE AREAS		
Office space	100	
Small tools and parts	700	
Issue area	100	
Secured sales	600	1,500
CLASSROOM		
Classroom	600	
Storage room	50	650
SERVICE AREAS		
Mens' toilet & locker	240	
Womens' toilet & locker	150	
Wash areas	200	
Vending area	50	
Custodial	70	710
TOTAL NET AREA		12,060 square feet
CIRCULATION		4,340 square feet
CONSTRUCTION		600 square feet
GROSS BUILDING AREA		17,000 square feet
TOTAL NUMBER OF AUTO STALLS		25

CHAPTER 4
Space Planning Concepts

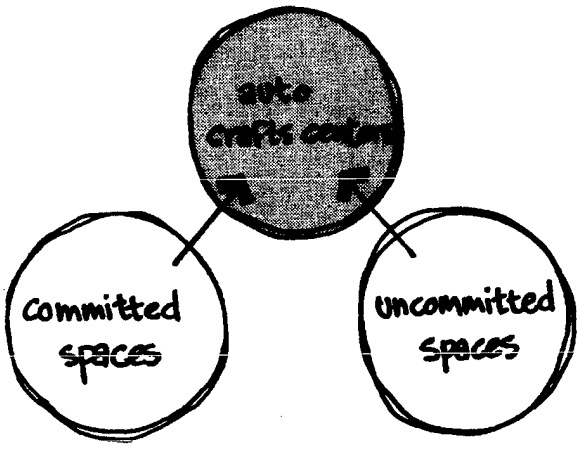
4-1 Conceptual Diagrams

a. Space planning involves arranging the elements of a plan in response to the functional requirements of the programmed activities. The interrelationships of the activities themselves are the most variable factors in the interpretation of the program. Planning, however, must take into account the probability that future space requirements will change because of program modifications.

b. Most buildings incorporate two types of spaces: committed and uncommitted. Committed spaces are those that are designed or used for only a particular activity because of specific requirements or spatial configuration. On the other hand, uncommitted spaces have an amorphous character, allowing them to be used for many unspecialized functions.

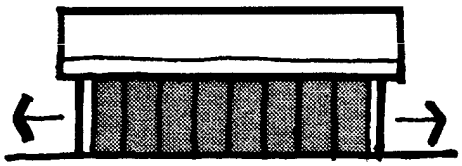
c. Auto craft activities require both types of spaces. Part of the planning process is to identify and, where possible, consolidate those conflicting spaces which have similar environmental requirements, while separating those conflicting ones.

d. The conceptual diagrams that follow illustrate design concepts for the building as a whole responding to differing climatic conditions, site constraints, and space use requirements.

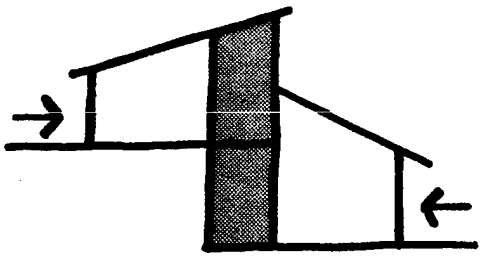


Space Types

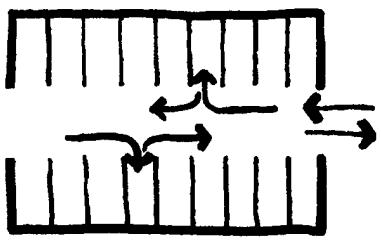
Diagrams



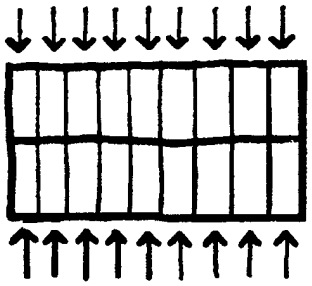
(1) *Horizontal* design concept best suits an unrestricted level site, with direct indoor-outdoor access and flow between activities. Initial construction cost is lower and expansion can occur more readily.



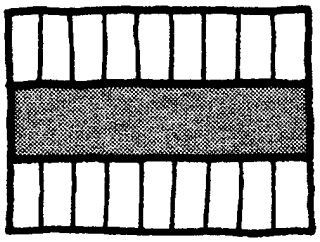
(2) *Vertical* design concept may be required to meet site or terrain restrictions but care is required for vertical continuity and communication.



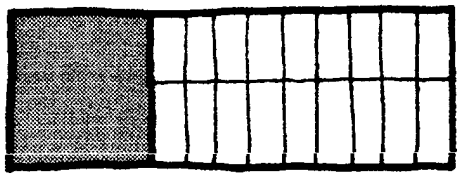
(3) *Internal Access* design concept utilizes interior aisles for vehicular circulation and access to work areas.



(4) *External Access* design concept takes advantage of exterior areas for vehicular circulation and access to work areas. This eliminates the need for indoor aisles but increases the number of exterior doors required.



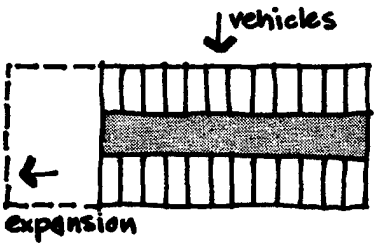
(5) *Central and Linear Core* design concepts have work areas oriented around central support facilities.



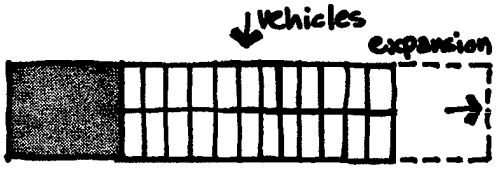
(6) *Separated Core* design concept places support functions in a committed space isolated from work areas.

4-2 Functional Layouts

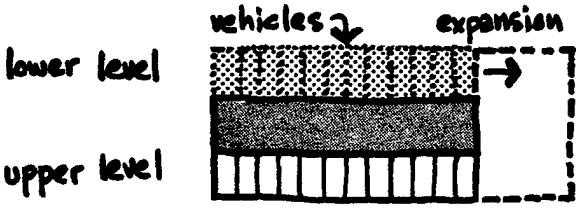
a. The following layouts indicate various concepts for the arrangement of the major functional areas of an Auto Crafts Center. The core area shown in a gray tone includes the support facilities such as the machine and welding shop, office, tool issue and parts sales, classroom, storage and toilets. The areas shown in white are the auto stalls and the arrows indicate vehicular circulation. It should be noted that the circulation pattern is always a primary design factor.



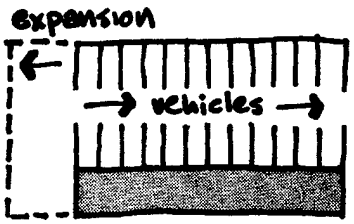
b. Layout using *horizontal, linear core* and *external access* concepts. This layout provides convenient access to support facilities from the auto stalls. In warm weather, individual auto stall doors can be opened to provide good ventilation; however, the large number of doors increases heat loss in cold weather. This plan minimizes interior vehicular circulation space and permits visual control of the entire work area, although it provides no central control of vehicles entering and leaving the building.



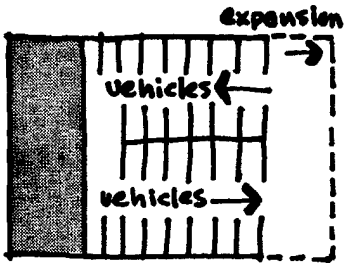
c. Layout using *external access* and *separated core* concepts. This layout has the advantages of excellent natural ventilation in warm weather and a minimum amount of space used for interior vehicular circulation. Disadvantages include high heat loss in cold weather, high initial cost of providing many overhead doors, a long distance between the core area and some of the auto stalls, and poor control of vehicles entering and leaving the building.



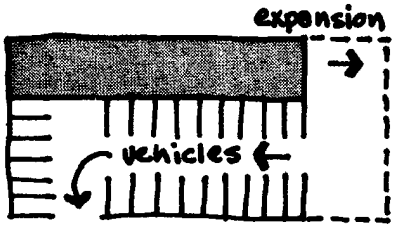
d. Layout using *vertical, linear core* and *external access* concepts. To take advantage of site conditions, a two level layout can be developed using the above concepts. The disadvantage of this layout may be the intercoordination of functions and activities.



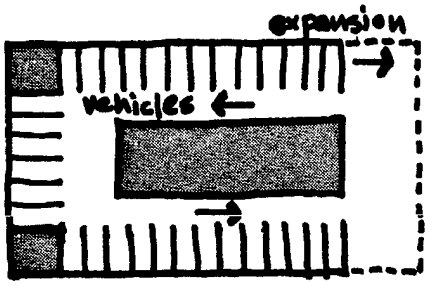
e. Layout using *internal access* and *linear core* concepts. This layout has a vehicular entrance and exit at opposite ends of the building which reduces heat loss and initial cost of overhead doors. The plan allows control of vehicles entering and leaving the building, however, it also requires much more space devoted to the interior circulation of vehicles.



f. Layout using *internal access* and *separated core* concepts. This U-shaped aisle layout has both vehicle entrance and exit on the same side of the building. This plan is particularly appropriate when site conditions restrict vehicular access to one side of the building. Although the plan minimizes exterior vehicle circulation space, more interior space is required for turning.



g. Layout using *internal access* and *linear core* concepts. This L-shaped aisle layout is appropriate for a site restricted on two adjacent sides. The plan provides good control of vehicular circulation, however, additional space is required for turning.



h. Layout using *central core* and *internal access* concepts. This layout has a very compact form and a single vehicle entrance/exit which are both advantageous in very cold climates. Although traffic flow is easy to supervise with only one entrance and exit, some interior space is lost because of single loaded aisles and area needed for turning.

CHAPTER 5
Illustrative Examples

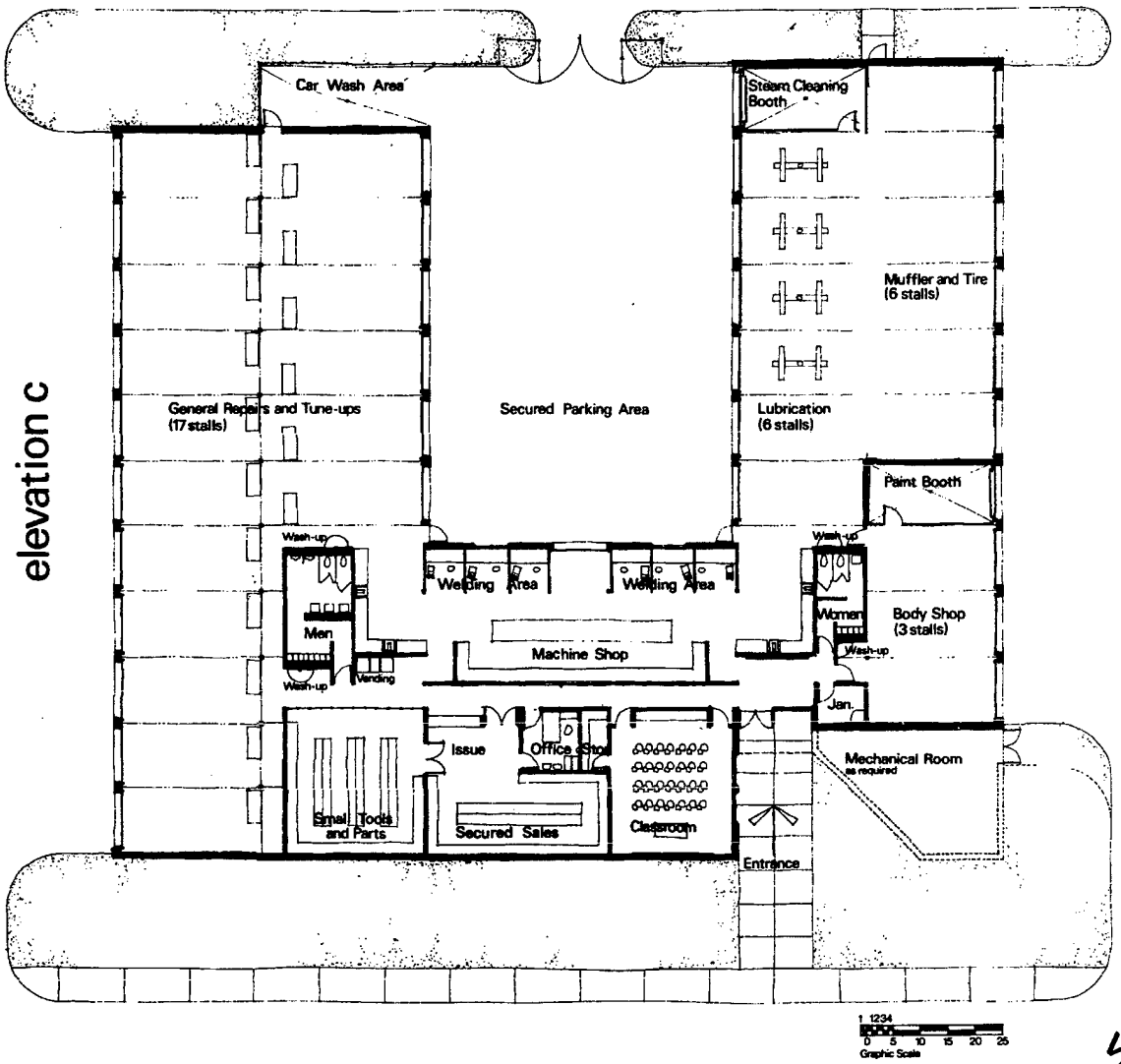
5-1 New Facility Design

a. Examples A and C contain the authorized area of 17,000 square feet and 34 auto stalls (paragraph 3-5 Table A) with an individual vehicle entrance to each stall. Example A, shown with suggested elevations, is a U-shaped plan which breaks excessively long runs of overhead doors and is more pleasing in appearance from the street. Aesthetics is especially important if the center is to be located in an area that is not industrial in nature. Various support activities are located conveniently between the general repair and tune-up stalls and the specialized work stalls.

b. Example B shows an Auto Crafts Center with interior vehicular circulation. It is based on the criteria and space allocation discussed in paragraph 3-5, Table B. Because of the increased area required for interior circulation, only 25 auto stalls are provided instead of the 34 auto stalls authorized for a 17,000 square foot facility. All other areas remain the same size. The facility can be expanded at either end without altering the supporting areas.

c. Example C is similar to Example B except the interior vehicular lane has been eliminated. The result is a long building with vehicle access along the front and back directly to each stall through individual overhead doors. The space used for interior vehicular circulation in Example B has been used to provide the nine additional authorized auto stalls in this example.

Design Solutions

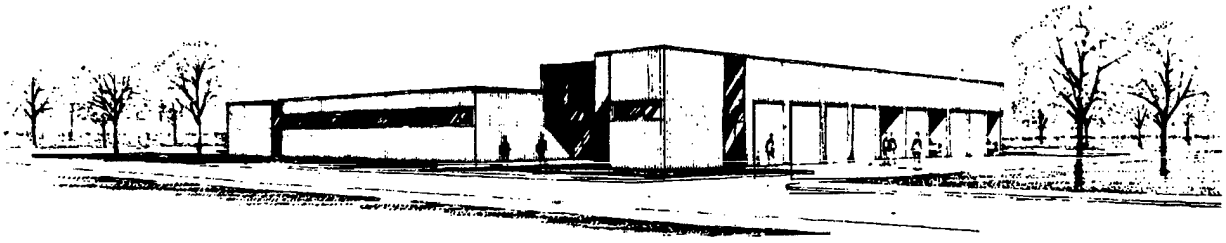


elevation c

Example A
34 Stalls

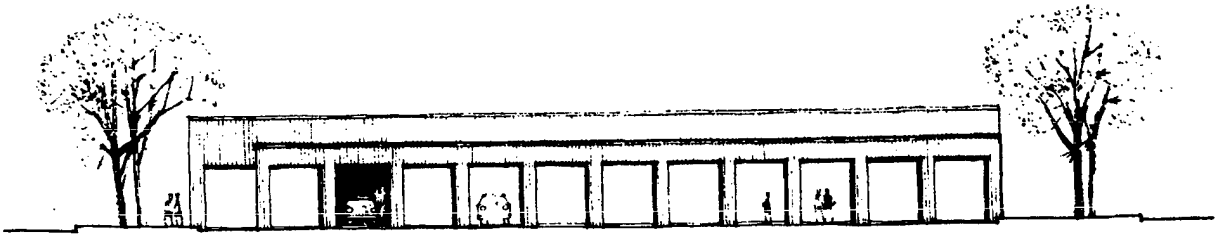
elevation b

view a



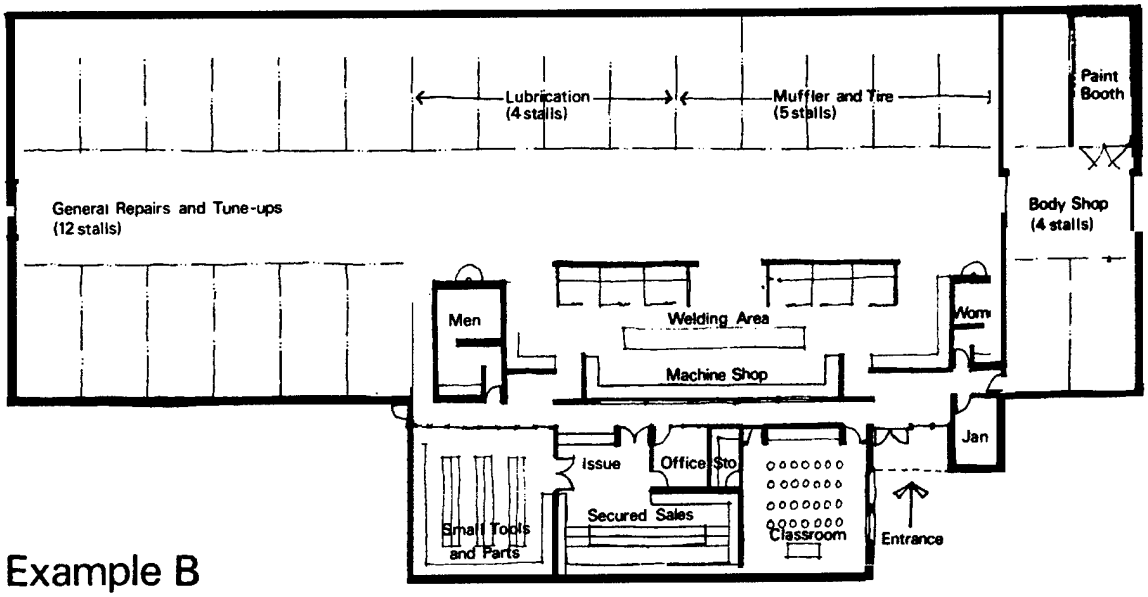
view a

elevation b

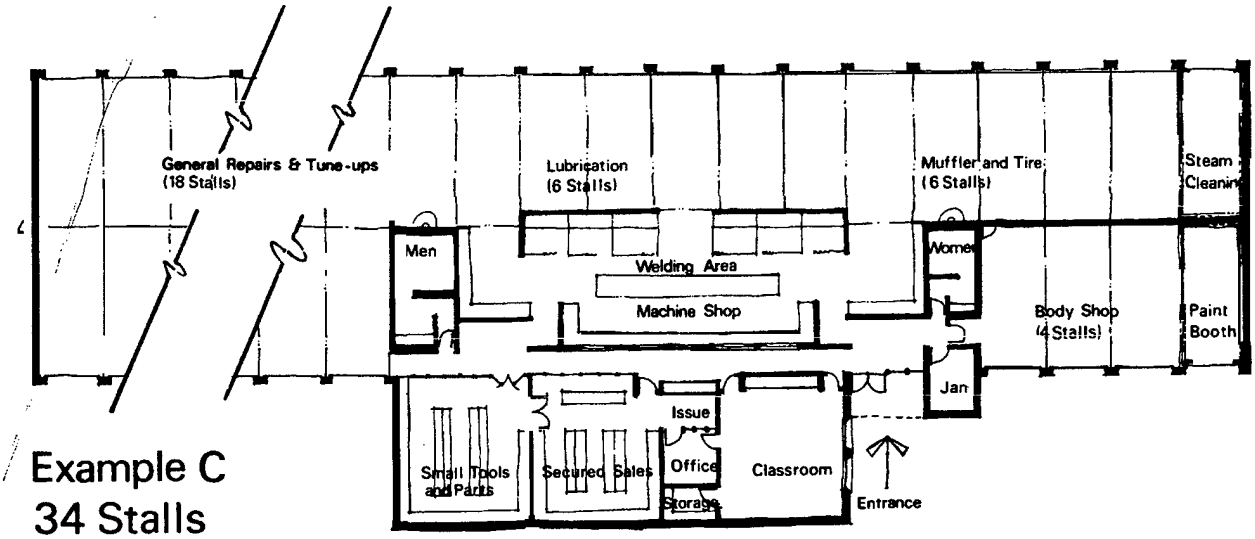


elevation c

Example A



Example B
25 Stalls



Example C
34 Stalls

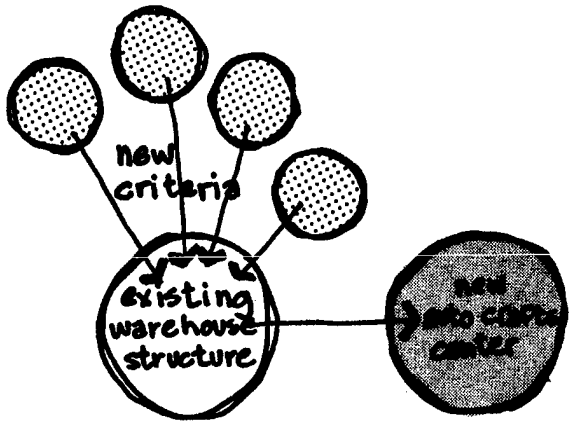
5-2 Conversion of Found Space

a. As the mission or needs change at any installation so do the requirements for particular types of facilities. Thus there is frequently the opportunity to recycle buildings designed for specific uses into functional, economical solutions serving entirely new activities.

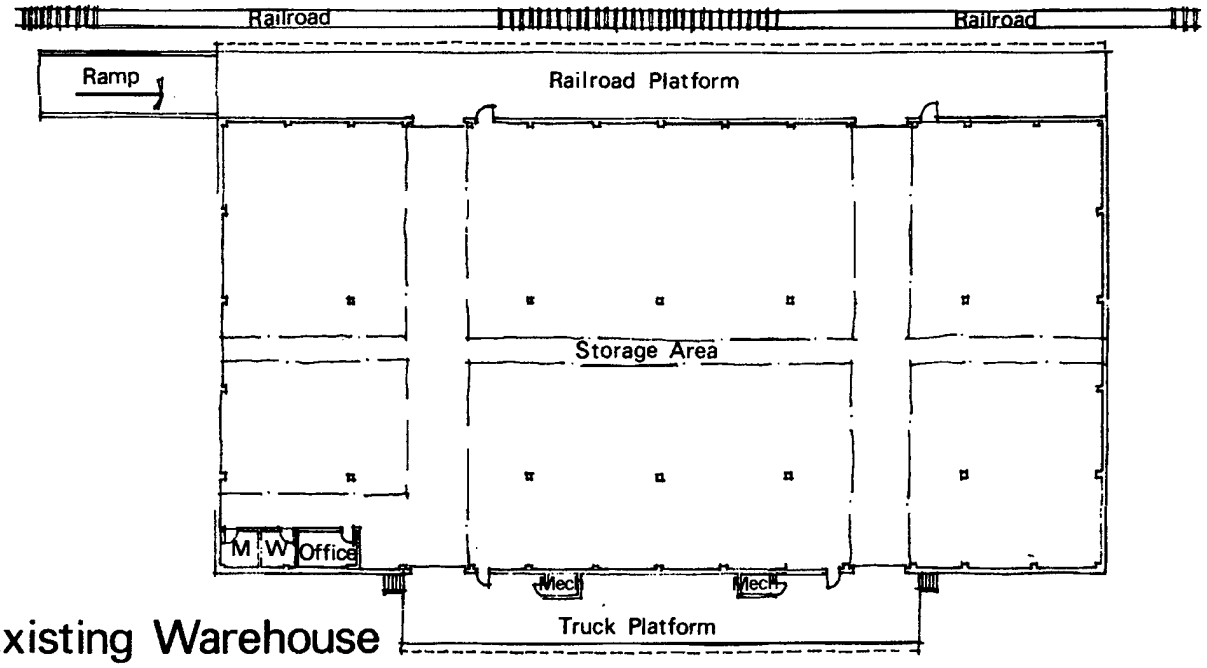
b. To illustrate this point, the following drawings show the conversion of a common warehouse structure into an Auto Crafts Center. The basic description of the original structure is a "Warehouse, Flammable Materials, with Platforms & Canopies, 100' x 200'" as taken from Corps of Engineers Standard Design 33-02-68, dated 19 February 1953. The design solution converts it into an Auto Crafts Center roughly equivalent to other facility types included in this Design Guide.

c. The 20,000 square foot structure provides 31 stalls within the confines of the existing walls, arranged with limited vehicular access from the exterior through existing doors. To the rear, on the railroad platform a prefabricated paint booth and space for steam cleaning adds to the vehicle capacity. Because the floor level is above grade, three ramps have been added, and limited infilling is provided under the front canopy to provide space for an office. Parking for 7 vehicles is provided between the front ramps and additional car storage and parking is available on the sides.

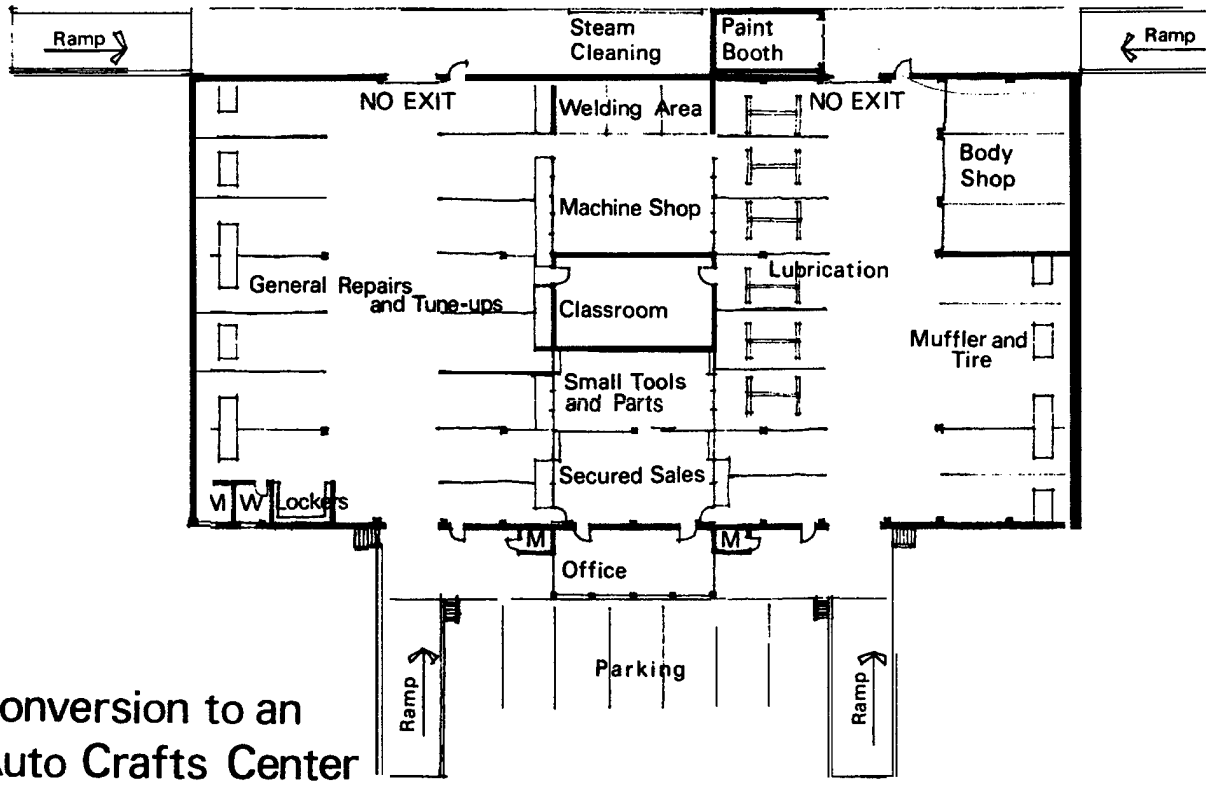
d. This solution is hypothetical and there are many factors to consider in converting found space. Paragraph 2-12 of this guide explores this process in depth.



Conversion



Existing Warehouse



Conversion to an Auto Crafts Center

*U.S. GOVERNMENT PRINTING OFFICE: 1978 260-819/3007 1-3